From T. D. Emery
for
Chas. L. Smith

DISCOVERY

OF A

Lost Art of the Egyptians

THE ROBBINS PROCESS

FOR

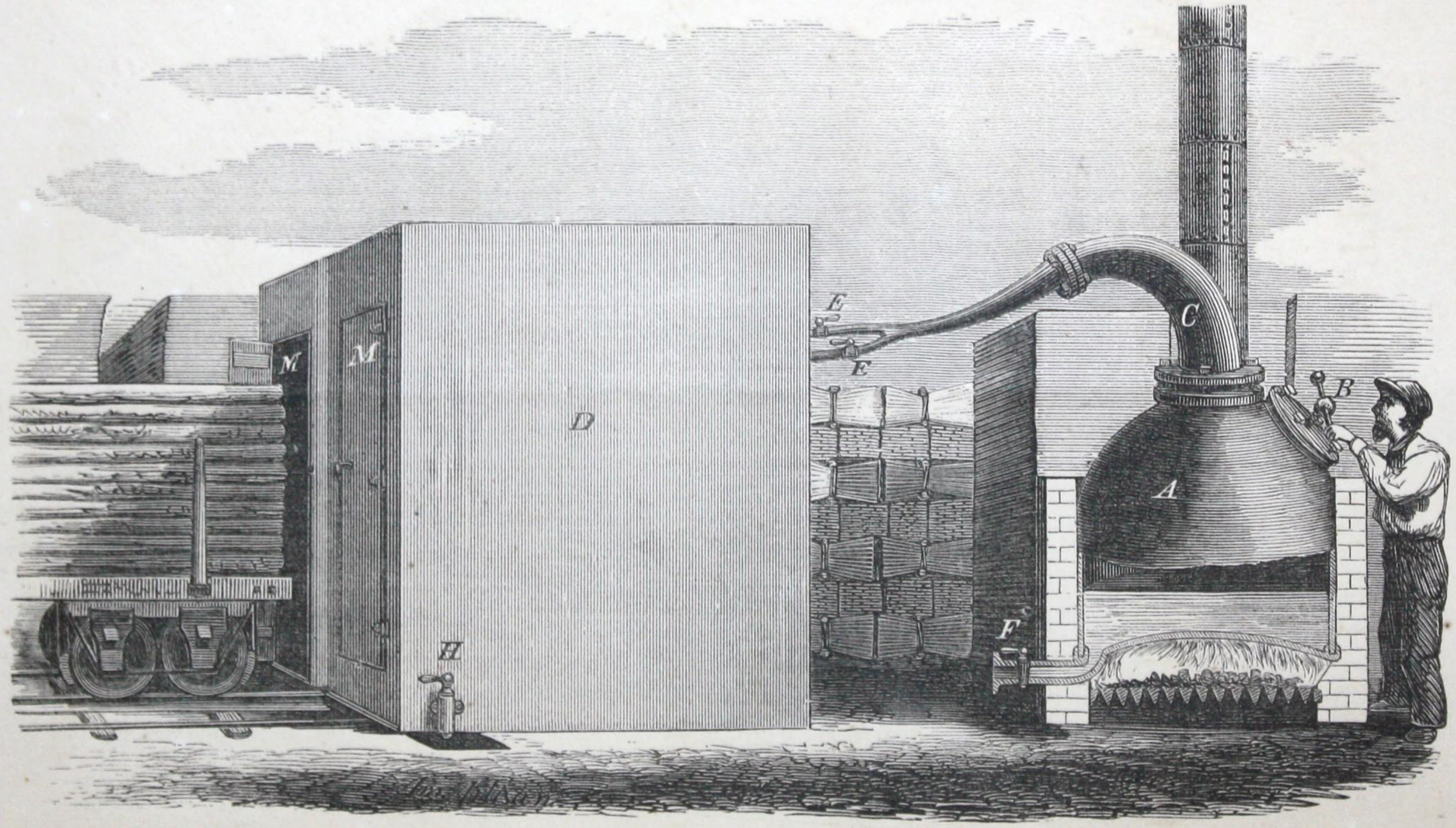
Rendering Wood Imperishable.

Wood preserving

AN INVALUABLE IMPROVEMENT, SUSCEPTIBLE OF UNIVERSAL APPLICATION.

"The Man who adds a Science or an Art,
Or new INVENTION, practically wise,
Leads the great host."

NEW YORK:
PUBLISHED BY ORDER OF THE
NATIONAL PATENT WOOD PRESERVING COMPANY,
No. 68 BROADWAY.
1867.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THE

NATIONAL PATENT

WOOD PRESERVING COMPANY.

ORGANIZED UNDER THE LAWS OF NEW YORK.

Capital Stock, . . $1,000,000.

Divided into 10,000 Shares of $100 Each;

1000 SHARES—$100,000 WORKING CAPITAL.

OFFICERS.

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HENRY STEERS, - - - - - *Vice-President.*

I. C. WOODS, - - - - - - *Secretary.*

EUGENE KELLY, (No. 24 Nassau Street, New York,) *Treasurer.*

S. B. BRITTAN, *General Agent.*

NEW YORK:

OFFICE—No. 68 BROADWAY,

ROOMS 11, 12 & 13.

1867.

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ANNOUNCEMENT.

THE NATIONAL PATENT WOOD PRESERVING COMPANY, having purchased the new Invention for Preserving Wood, patented by LOUIS S. ROBBINS, is now prepared to use, and to sell the right to use, said Invention in Towns, Cities, Counties and States, to individuals, to Railroad Companies and other Corporations. All applications to the Company will receive immediate attention.

J. RICHARD BARRET, President,
HENRY STEERS, Vice-President,
I. C. WOODS, Secretary,
} *Executive Committee.*

S. B. BRITTAN, General Agent.

OFFICE OF COMPANY,
68 *Broadway, New York.*
Sept. 1st, 1866.

GENERAL INDEX.

ART OF PRESERVING WOOD.

THE importance of preserving wood for mechanical purposes can no longer be questioned. Timber, conveniently located—within a reasonable distance of the chief centers of the lumber trade—must soon be exhausted. We shall, ere long, be obliged to draw our supplies from situations remote from the main channels of water communication—from the gradual slopes and steep acclivities of the great mountain ranges which traverse the continent. When the country along the chief lines of railway shall also have been stripped of such building materials, we shall be compelled to look to other, still more distant, and comparatively inaccessible regions for what we require; and from such sources it will only be obtained by great labor and at a heavy expense. A very large portion of the country embraced within the geographical limits of the new States and Territories, is, even now, very poorly supplied with wood. In Nevada a single railroad sleeper is worth double the average price in the Eastern and Middle States. A rough knotty stick, five feet long and one foot in diameter—only fit to prop up the roof of a mine—is worth *one dollar in gold*. The rapid settlement of that country, and of the whole Pacific side of the continent, will soon render wood, of all the materials employed in the useful arts, the most difficult to be obtained.

But the world scarcely realizes the existence of a great

and general demand before it is supplied. The resources of Nature, the triumphs of the human mind, and the order of Providence, all combine to meet the chief necessities of every age. Perhaps no more important discovery has been made, in the department of the useful arts, than the new process of preserving wood, for which Mr. Louis S. Robbins has received Letters Patent. The metallic compounds employed by several European inventors had all substantially failed. To say the least, the processes were all expensive, the machinery imperfect, and the results unsatisfactory. The process of Mr. Bethell, of England, has been employed with far greater success than any other, especially in the preparation of railroad sleepers. He rejected the metallic solutions, and in their stead used an oleaginous compound obtained from coal tar. The means he employed to remove the atmospheric pressure and the moisture from the wood—to the end that the oily compound might be made to permeate its substance—were expensive and only partially effectual. In Mr. Robbins' process the high temperature and the vapors of oil remove the air and moisture so effectually that the wood readily receives the liquid oil longitudinally through all its pores. When heavy timber is to be prepared, it is not necessary that the oil should penetrate to the center. To facilitate the process in such cases, and to economize time and material, the oil may be applied in liquid form, after the hot vapors have expelled the moisture, and the albumen of the sap has been completely coagulated by the application of heat and the introduction of the creosote in the vapor. The superior advantages of this process may be briefly stated as follows:

1. The hot vapors immediately force out a large portion of the air from the chamber; the surface moisture is dissipated and the wood sufficiently seasoned.

2. The materials used in the process are so expanded by heat as to fill more than 1,000 times the space they occupy in the liquid state. Being rendered thus subtile and penetrating, the elements essential to the result are readily admitted into the smallest pores of the wood.

3. The heat accelerates the capillary action or molecular attraction; and hence the antiseptic matter is conveyed more speedily and fully through the fibrous portions of the wood.

4. The apparatus is simplified; and, for the reasons already stated, the process is rendered more rapid and complete.

5. The wood treated by this process is left *clean* on the surface, and may be freely handled and immediately used for any purpose.

6. If designed for out-buildings, fences, agricultural implements, or any other purpose in which ornament is not an object, the wood requires no paint, but where paint is to be used, the wood is most thoroughly prepared to receive it, being already primed in the most perfect manner.

7. The wood in which the pores are largest, and the ligneous fiber least compact, is rendered nearly as hard and quite as imperishable as the finest grained timber.

8. The very nature of the materials with which the wood is impregnated, naturally renders it impervious to moisture; and experience has already demonstrated that wood so prepared is comparatively imperishable.

9. Neither science nor extraordinary skill is required in conducting the process, and the most perfect treatment under the patent involves but a trifling expense.

In situations where it is constantly exposed to varying degrees of temperature and moisture, wood decays in a short time. The sills and sleepers of buildings, in moist

places, with little or no circulation of air beneath; the fence posts set in the ground, and railroad ties, seldom last over five years. The decay of timber employed for these purposes is immense, so great, indeed, as to defy computation. In the few cases which admit of accurate estimates the facts are surprising, and fully justify the conclusion, that the actual loss to the country by the decay of wood—in all the various uses for which it is employed in the mechanic arts—must amount to thousands of millions of dollars every year. It is true that in many places, and for many uses, wood does not decay so rapidly as in the particular cases already named; still, if we could arrest this universal process of decay, but for one year, we should doubtless save enough to cancel the present national debt.

The reader's attention may now be called to a more specific statement of some of the particular uses to which this process for preserving wood may be applied with the greatest advantage.

RAILROADS.

In respect to the timber used for sleepers, we can determine the annual waste, by the ordinary process of decay, with considerable precision. It requires 2,500 ties or sleepers for a single mile of railway. These are furnished at an average cost of one dollar, including the expense of laying down the same. As they must be renewed as often as once in five years, it will be perceived that the annual decay is at the rate of twenty per centum on the original cost; or, annually, $500 per mile. The 50,000 miles of railtracks, now in the United States, necessarily require for their support 125,000,000 of sleepers. These must inevitably be replaced, once in about five years, at a cost of one dollar each; hence it will be percieved, that the annual ex-

penditure for this purpose is some 25,000,000 of dollars. As the Robbin's process is sure to preserve them for a quarter of a century, and thereby render it unnecessary to change them during all that period, it follows that this immense sum (less the cost of the original treatment under the patent) may be annually saved to the country. For the local structures—depot buildings, store houses, machine shops, bridges (the latter need not be covered), and the immense rolling-stock of our great railways, this process is scarcely less valuable, and its application to these uses must greatly increase the dividends of our railroad corporations. When the woodwork of the cars is otherwise completed, it may be readily subjected to this treatment; and thus the same process will thoroughly season the wood, fill the pores and fibrous portions with powerful antiseptics, and cover the surface far more effectually than any priming known to the painter, leaving it in the most perfect condition to receive an ornamental finish of paint and varnish when that is required.

But we have not yet fully estimated the evil of the present rapid decay. In the course of three years after the construction of a railroad the ties begin to decay so rapidly, that it becomes necessary to remove a greater or less number of the same in every succeeding year. This frequently obstructs travel and delays the transportation of merchandise over the road. Moreover, the repairs of necessity disturb the bed on which the sleepers rest, and whatever unsettles the foundations of portions of the road is liable to render it less secure as a whole, and the chances that accidents will occur are indefinitely multiplied.

AGRICULTURAL IMPLEMENTS.

The Agricultural interest is the one upon which the true

wealth of nations primarily and chiefly depends ; it follows, therefore, that a vast amount of capital is necessarily invested in the implements of husbandry. The inevitable exposure of these to all the vicissitudes of temperature and moisture in a short time renders them useless. If they do not immediately decay, the vitality and elasticity of the wood are soon destroyed, so that it is easily broken. The process here offered to the public affords a sure protection against the destructive effects of oxygen and moisture, and thus preserves such implements until they are literally worn out by attrition.

BARRELS AND CISTERNS.

We annually require millions of barrels, casks of various sizes, and large cisterns for the spirits and oils of every possible description, and all the liquid products of our manifold industry. These barrels are now made from seasoned timber, making it necessary for the manufacturer to invest a large amount of capital in the quantity which must be kept on hand; besides the timber is liable to be damaged for such purposes—while it is being seasoned—by small worms that bore through it in all directions. Green timber can be employed for this purpose, provided it be first treated by Mr. Robbins' process. This offers an advantage which will be readily appreciated by every barrel manufacturer. A very large proportion of the packages intended for transportation, both in our domestic trade and foreign commerce, are put up in this form; and the contents of such packages probably represent more than one-fourth of the market value of the elements that enter into the commerce of the world. The certain exposure of such packages to all the changes of temperature and degrees of

moisture results in an incalculable waste of valuable merchandise. Hence, all the wood employed for such purposes should be so prepared, that it will effectually resist the ordinary action of the elements.

BRIDGES, PIERS AND WHARVES.

The application of the Robbins process to the lumber employed in the construction of these works, is of great practical importance. Such superstructures are ncessarily among the most expensive within the whole range of mechanical art. But the cost of bridges may even be diminished, if the materials are first subjected to this treatment, for the reason that they require no covering to protect them from the elements; the expense of the roof and enclosure being entirely saved.

But our estimate of the importance of a proper preparation of the lumber used for such purposes is not to be determined by merely commercial or financial considerations. In respect to bridges, at least, it intimately concerns the *safety* of the whole community. Without such a preparation, the piles and other timbers used in the construction of bridges soon decay; besides they may be weakened by insects that bore them beneath and above the surface of the water. The treatment here proposed, not only preserves the whole structure from decay, but it also protects it from the naval worm and the parasitic fungi, which produce the dry rot.

HOUSES AND OUT-BUILDINGS.

In our own country the dwellings of 25,000,000 of people are chiefly made of wood; and in the world there may be 600,000,000 who dwell in wooden habitations. A still larger proportion of all out-buildings are of such perishable

materials, especially the shingles so generally used for covering the roofs, and which should always be treated in the manner herein proposed. No reliable estimate can ever be formed of the loss to the world by the decay of buildings. Not only the materials perish, but all the labor expended in fashioning the same into the innumerable forms of use and beauty is likewise lost. The proposed treatment of lumber for such purposes, besides saving the priming coat of paint in all cases, would so increase its durability, that a large portion of the labor now expended in erecting human habitations and other structures of wood, could be at once directed into other profitable channels, thus augmenting the wealth of all civilized nations.

FENCES.

The preparation of fencing materials certainly suggests one of the most important uses to which the new process for preserving wood can be applied. Some years since, Mr. John S. Skinner, while editing the *Plow, Loom and Anvil*, after a painstaking investigation of the subject, prepared and published a series of papers in which he is led to conclude—from all the information in his possession—that the setting and repairing the fences of the United States actually cost the country as much as the building of the towns and cities. Especially in those portions of the Union where the people are obliged to use sawed lumber—obtained from a distance, as in Illinois and other parts of the great West—this process of treating wood must be of incalculable value, as fences so prepared and properly set will last for generations.

CARRIAGES AND CARS.

The process here offered is also important in the preparation of lumber for vehicles of every description. Millions

of dollars are invested in this business, and this treatment, especially as applied to the hubs of carriages, is of great practical utility. Without it the hubs soon check or crack in such a manner as to loosen the spokes, and thereby destroy the integrity of the whole wheel. Moreover, the timber chiefly used for hubs is that part of the trunk nearest the ground, the portions further removed from the root being too soft for that purpose; but this treatment renders the higher portions of the tree, if otherwise suitable, not less valuable for this particular purpose.

FURNITURE AND MUSICAL INSTRUMENTS.

The utility of applying this treatment to furniture and the cases of musical instruments will be obvious on a moment's reflection. 1. Green wood may be used, thus obviating the necessity for the investment of a large capital in lumber. 2. The varying degrees of moisture will not cause the wood so treated to alternately swell and shrink. 3. Its tendency to warp and crack is greatly diminished. 4. The wood—both surface and substance—is most effectually oiled. 5. Soft woods are rendered much harder than before, and hence susceptible of a higher polish. 6. The wood becomes more resonant by this treatment, which is important if it is to be used for the cases of organs, pianofortes and melodeons.

PLANK ROADS AND WOOD PAVEMENTS.

The chief objection to plank roads and wood pavements is based upon their sure and rapid decay, and the necessity —after two or three years—for constant repairs. The treatment of wood for these uses will, it is believed, entirely obviate this objection. Not only is the wood preserved from decay, but it is much less liable to warp and check;

at the same time this treatment must so increase its capacity to resist abrasion, that it will wear much longer.

TELEGRAPH POLES.

In 1860, all Europe had 130,000 miles of telegraph, and at that time the United States alone had more than 50,000 miles. It is doubtless safe to estimate the present aggregate length of all our telegraph lines at 60,000 miles. If we allow forty poles to the mile, it will be perceived that 2,400,000 poles are required for the lines already existing in this country. The average cost of these—including the labor of preparing and putting them up—may be estimated at five dollars each, or $12,000,000 for the whole number now in use. More than double that number of poles is required for the existing lines in Europe, where they are presumed to cost more than in this country. From these facts and estimates we are authorized to conclude, that the amount of capital invested in telegraph poles in Europe and the United States is not less than 40,000,000 of dollars. If we assume that they will last twelve years (this is not probable), the annual cost of replacing the decayed ones is more than 3,000,000 of dollars, which may be saved by subjecting telegraph poles to treatment under the Robbins patent.

BUILDING OF SHIPS.

Under this head we comprehend all ships, steamers and boats of every description, employed in the navy, and for the transportation of passengers and merchandise in the commercial and international intercourse of the world. The importance of rendering wood indestructible, at least in a qualified sense, for the purposes here indicated, cannot be

too highly estimated. The vast sums expended in naval architecture, and in the whole merchant marine of all nations, are now measurably thrown away on account of the perishable nature of the materials employed. Before the late war, some of the vessels intended for our navy decayed on the stocks, or were damaged by worms to such a degree that it became necessary to replace many of the timbers before these structures were completed. The builder scarcely kept out of the way of the destroyer. Our mechanical industry is sacrificed when we have only perishable and worthless memorials of its greatest achievements.

The loss in consequence of this rapid decay is so great, that if it were in our power to submit accurate estimates of the same, the figures would astonish the whole community. Not only is this great loss unavoidable, so long as we use timber that has simply been prepared by the ordinary process of seasoning, but incalculable wealth, in the shape of merchandise, goes to the bottom of the ocean, every year, merely because our merchant vessels and steamers have been so far impaired, by the decay of some of their timbers or otherwise, that they give way, and the whole fabric goes to pieces amidst the strife of the elements. Thousands of lives are also lost from the same cause. This fearful destruction admonishes us that the timbers of which we build our ships of war, foreign packets, merchant vessels, life-boats, etc., should be made of materials that are water-proof, worm-proof, and, if possible, time-proof. Not only does the Robbins process preserve the wood from the destructive powers of oxygen and moisture, and from the ravages of the *Teredo Navalis*, in the most perfect manner possible, but this treatment by oleaginous compounds likewise prevents the corrosion of the metallic bolts, spikes and nails, employed in the construction of all such works.

BURIAL CASES.

The common desire we all feel to preserve the remains of the dead has led to the extensive use of metal cases instead of coffins made of wood. These are not only expensive, but they soon corrode, and it is questionable whether the best of them will last longer than twenty or thirty years. It is believed that wood thoroughly treated under the Robbins patent will last a century in the ground. The cases found in the tombs of Egypt, where they have remained for 3,000 years, are generally in a good state of preservation. It is well known that these cases were prepared with bituminous substances, and that the same were used with the pyroligneous acid of wood in the process of embalming their dead.

We have, in the extreme Southern portion of our country, large quantities of perishable wood (cotton-wood and other soft varieties) which may be made available by the application of this treatment, in the construction of railroads and for other purposes. In Mexico and South America—where the ordinary decay of wood is more rapid than in more northern countries—it is believed that a great market may be opened for the sale of railroad timber and other lumber, provided the same be rendered durable by the treatment, herein proposed.

AMERICAN FORESTS.

THEIR DESTRUCTION AND PRESERVATION.

In the last Agricultural Report emanating from the Department at Washington, there is a very elaborate paper on the rapid destruction of our Forests. The author lays before the country a mass of statistical information which cannot fail to startle all who properly estimate the importance of the subject. From facts and figures, which we are not prepared to dispute, he is led to the conclusion that we shall have *a famine* for wood in this country, within the next thirty years, unless immediate measures are adopted whereby the supply may be augmented, or the destruction of what remains greatly diminished.

It is true that coal and peat may be substituted for wood, as fuel, but for a vast number of purposes in the Mechanic Arts we can furnish nothing that will take the place of wood. This fact gives to the whole subject a grave importance; and when we remember that the market value of lumber is constantly increasing, and that every year diminishes the resources of our country, in this respect, we think there may be substantial grounds for the serious apprehension suggested by the Report from the Agricultural Bureau. We submit the important portions of that part of the Report:

There are few subjects so closely connected with the wants of society, the general health of the people, the salubrity of our climate, the production of our soil and the increase of our national wealth, as our forests; and yet no interest of our country has received so little attention at the hands of the people, and enjoyed so little of fostering protection from the Government.

It is my intention in this article, by a simple array of important facts and a few passing suggestions, to call the attention especially of our land-

holders, farmers, and mechanics to an impending national danger, beyond the power of figures to estimate, and beyond the province of words to express. If I can influence these classes but a little; if but a few facts shall be added to the present knowledge possessed by each; and if, therefore, but a slight effort be put forth by every one of them, the aggregate of interest, intelligence, and action thus obtained will be immense. There were in the United States in 1860, 2,044,077 farms under cultivation. Could each farmer, having timber on his own land, be led by the facts presented to so husband his trees, or improve their quality, or replace judiciously and speedily those removed, as to equal one-half acre of common forest each year, and if those whose lands are destitute of timber could be led to plant the equivalent of one-half acre per annum, we should either save or produce, annually, 1,022,038 acres, which would be something toward offsetting the destruction, and warding off the coming desolation.

It is feared it will be long, perhaps a full century, before the results, at which we ought to aim as a nation, will be realized by our whole country, to wit: that we shall raise an adequate supply of wood and timber for all our wants. The evils which are anticipated will probably increase upon us for thirty years to come, with tenfold the rapidity with which restoring or ameliorating measures shall be adopted. Every hour, therefore, is precious. We have, as a nation, far too long disregarded this interest. Growth is slow and restoration tedious, while destruction is rapid and instantaneous. Delay, therefore, is both cruel and disastrous to ourselves.

Among the things which are most fundamental to a nation's material growth and prosperity, we name these four—cheap bread, cheap houses, cheap fuel, and cheap transportation for passengers and freights. A nation which produces the raw material for every species of manufactures and commerce, and that at low cost—whose people provide their own houses, and raise all they consume—which can move its people, its products, and manufactures, quickly and cheaply, is in a condition to establish the most complete division of labor, and to give to every man the results of his abilities, energy and skill. Such a nation must prosper. Its people will save and accumulate immense sums from their respective earnings; and this question of wood enters largely and constantly into each one of these four great departments of iudustry and living. * * * * *

The older portions of our country are, even now, drawing their supplies of lumber from the newer States. For black walnut, and some other woods, used in cabinet manufactures and in carriage-building, the eastern States are already sending to Michigan and Wisconsin, while tens of millions of dollars' worth of pine are brought about two thousand miles from our upper lakes and the head waters of the Mississippi to our Atlantic and Gulf seaboard. Foreign nations, also, are consumers of our forests. Oak and pine are ex-

ported by us to other countries for purposes of house and ship carpentry. A single gun factory in Europe, during the first two years of the rebellion, consumed 28,000 walnut trees to supply gun-stocks for the American market. This fact will give some indistinct idea of the consumption of lumber in great factories of cabinet ware, where the amount of wood required for the smallest article exceeds that required for the stocking of a musket.

In the State of New York alone, within the ten years from 1850 to 1860, there were brought under cultivation 1,967,433 acres of land hitherto unimproved. As there are scarcely any lands in the State of New York naturally untimbered, it is probable that during those two years more than 1,500,000 acres of what had been (or was then) timbered land, was cleared for purposes of lumber and agriculture. Thus, 500 acres of land were changed from wood-bearing and timber-growing, each day, for 300 days each year, through that period of ten years, into farming lands.

During the same ten years more than 50,000,000 of acres in our whole country were brought under cultivation. But these improvements were especially made in Iowa, Kansas, Minnesota, Wisconsin, Illinois, Indiana, Ohio and Texas. These States, to a greater or less extent, are dotted with prairies, or suffer from a scarcity of timber; many prairie farms were, therefore, taken up. But bear in mind that every man seeking a prairie farm desires, in his selection, to secure small streams and as much timber as possible upon his farm, or near to it; so that, while the reckless waste which attends new clearings in forest districts has not existed in the case of these prairie farms, their owners have wonderfully diminished the very scanty supply, even while they have dealt with it with an economy almost penurious. We will allow, then, for unwooded country brought into cultivation, two-fifths of the whole, (which is probably more than twice as much as was the fact;) this will leave three-fifths of the 50,000,000 of acres brought into cultivation, or thirty millions of acres, which were lands either previously or during those years heavily timbered. Assuming, as before, 300 working days in each year, 3,000,000 of acres were thus, each year, lost to tree-growing, or 10,000 acres each day.

In all regions remote from a market, and where logs and lumber cannot be readily exported, no matter how grand the forests, how excellent the timber, the trees are killed by girdling, and left to stand till overthrown by their own weight or by storms, and are then consumed by fire, yielding in return for their displacement only ashes to act chemically upon the soil, the fire often injuring the earth itself far more than the value of the ashes returned.

The lands thus stripped of forests are permanently alienated from timber-growing. In many places in the eastern States, where the mountains are too precipitous and rocky to allow of cultivation, a second growth of timber

is permitted and even cherished for firewood and the making of charcoal; but arable lands, once cleared, are scarcely ever permitted to be overrun a second time with forests. In fact, destructive man so utterly robs and impoverishes his lands of timber that he destroys the beauty of the landscape, and beyond the fence of his "wood-lot" leaves no shade for man or beast.

Increasing population swells these evils. Between 1850 and 1860 our population increased 8,080,785. It is now advancing at the probable rate of over one million souls per annum. The consumption and exportation of lumber in the United States, in 1860, was $37,390,310 more than in 1850. The ratio in this increase in population was but 35.59 per cent., while the increase in lumber was 63.09 per cent. This shows that the demand for wood for agricultural, mechanical and domestic purposes (notwithstanding all the use of iron in manufacturing useful implements, and the use of iron, stone and brick for bridge and house building) increases each year with the advance of the nation in age and wealth.

If for twenty years to come the demand for lumber shall advance in the same ratio to the population as in the past twenty, more than two hundred millions of dollars' worth of *American sawed lumber* will be needed each year, and the same ratio in the increase of population, which has called the fifty millions of acres into use in ten years, will then be calling it in the rate of more than 100,000,000 of acres each ten years. Our native-born and foreign population will have farms, lots and houses, fences, furniture, vehicles and agricultural implements; but every year they will impoverish the United States more and more of her lumber, and all these things will demand a higher price.

The great State of New York still holds pre-eminence as furnishing more lumber than any other State; but as long ago as 1850 it reached the maximum of its ability to furnish lumber. With the enhanced price of 1860, as compared with 1850, that State produced about one million of dollars less of lumber in 1860 than 1850; while the State during those ten years increased her population 783,341, she diminished her supply of lumber almost one million of dollars each year. Five other States in this Union also diminished their supplies of lumber during those ten years. Some of the newer States are developing their lumber interests; but our whole country (aided by foreign nations) is using up the products of their forests very rapidly.

Speaking of New York, the completion of a new railroad from Saratoga Springs northwestward, called the Adirondac railroad, and traversing the vast wooded region known as the "John Brown Tract," will, a few years hence, bring a great amount of lumber into market, which has hitherto been inaccessible. But it is doubtful whether even this will equal the amount of destruction, which will in the mean time, take place in other sections of the State. The black walnut has almost wholly disappeared from the State.

The wild cherry and cucumber tree are great strangers, the hard maple and hickory in some sections are nearly gone, while entire counties, formerly heavy with hemlock and pine, can with difficulty supply now and then a farmer with a knotty sill for a small barn ; and the opening of the mountainous Adirondac region, it is feared by many, will so let down the cold and storms of the northeast upon central and western New York, that, in the effect of the bleakness upon human health and the destruction of grain crops by intense cold, every foot of lumber secured therefrom for commerce and industry will cost double its value in the injury to other interests.

CONSUMPTION BY BUILDING RAILROADS.

The average cost of sleepers for one mile of railroad is one-eighth the cost of the iron, with these points of difference ; the iron, if of the best quality will last from twenty to twenty-five years, while the sleepers will last but from five to seven years, unless chemically prepared at a great increase of cost. Decayed sleepers are worthless, and are thrown away or given to the hands on the road for firewood. But, on the other hand, bruised, broken or split rails can be rewrought, and come a second time from the rolling-mill with little waste, and even of better quality than when first made. The mere cost of rough timber for sleepers will probably, in time, prove to many of our railroads an expense greater than the first cost of rails, even the keeping of iron rails in repair.

Between 1850 and 1860 there were built in the United States 22,204 miles of new railroads. New timber was required for all these. But for nearly 8,589 miles of previously existing roads there was needed, during this period for replacement of old timbers, more than the amount necessary for their first construction. So that there was used in that time 65,897,020 pieces of timber, costing, at the low average of thirty-five cents a piece, $23,063,957. But, besides all this, there were building and not yet brought into use, on January 1, 1862, about 17,827 miles of new road, for all of which new sleepers were needed. When it is remembered that these sleepers are generally sound hemlock, chestnut and especially oak ; that trees are selected to make them of a size just sufficient to furnish one or two sleepers only, (the tree being simply hewn on two sides, and having the heart entire,) the destruction of choice timber just approaching a size suitable for sawing is immense.

The lumber used in fencing their lines of railroads, (more than 60,000 miles,) and in erecting bridges, depots, station-houses and cars, is also a great item, to which we have but limited means of approximating ; and leaving it we will notice—

CONSUMPTION BY MECHANICAL INDUSTRY.

There are sixty-six occupations enumerated in the census which depend, in whole or in part, upon lumber or wood as their raw material for manufacture and commerce, employing a total of artisans of 476,623 souls, representing in their families, probably, more than 2,000,000 persons. We will enumerate a few of them: Carpenters, 242,959; coffin-makers, 7,000; cabinet-makers, 29,223; chair-makers, 6,341; sawyers, 15,000; millwrights, 9,063; ship-carpenters, 13,379; coopers, 43,624; wheelwrights, 32,693; piano-makers, 2,378; coach-makers, 19,180; and thus proceeding until sixty-six classes are specifically named. But there are others whose callings are very intimately connected with the use of wood and depending upon it, not at first sight occurring to the mind as their occupations are named. There are charcoal burners, 203; lime burners, 1,456, brick-makers, 13,736. How intimately are these trades connected with the entire destruction, the use and the manufacture of wood. All the occupations to which we have alluded are such that as our population increases, and the national wealth becomes greater, more persons will be demanded to labor in each, and the necessity for wood will become hourly more pressing. But we must not tarry. * * * * * *

Like the cloud "no bigger than a man's hand, just rising from the sea," an awakening interest begins to come in sight in this subject, which as a question of political economy, will place the interests of cotton, wool, coal, iron, meat, and even grain, beneath its feet. Some of these, according to the demand, can be produced in a few days, others in a few months, wool itself in a few years, but timber in not less than one generation, and such as we are daily destroying in not less than five to fifteen generations. The nation has slept because the gnawing of want has not awakened her. She has had plenty and to spare; but within thirty years she will be conscious that not only individual want is present, but that it comes to each from permanent national *famine* of wood. * * *

Bernard Pallissy, the famous "Potter of the Tuileries," who died in the Bastile for his religion in 1589, was one of the most profound men ever produced in Europe. He then plead for the wood in France as follows, (See G. P. Marsh, "Man and Nature," page 296:) "Having expressed his indignation at the folly of men in destroying the woods, his interlocutor defends the policy of felling them by citing the example of divers bishops, cardinals, priors, abbots, monkeries and chapters, which by cutting their woods have made three profits—the sale of the timber, the rent of the ground, and the good portion they received of the grain grown by the peasants upon it." To this argument Pallissy replies: I cannot enough *detest* this thing, and I call it not *an error, but a curse and a calamity to all France;*

for when the forests shall be cut, all arts shall cease, and they who practice them shall be driven out to eat grass with Nebuchadnezzar and the beasts of the field. I have divers times thought to set down in writing the arts which shall perish when there shall be no more wood ; but when I had written down a great number, I did perceive that there would be no end of my writing, and having diligently considered, I found there *was not any* which could be followed without wood." * * *

Hon. G. P. Marsh, than whom no man living is more competent to speak on this subject, thus warns his countrymen. His extensive travel, his high scholarship, his official position as United States Minister to several foreign nations, his wonderful powers of observation and deduction, give to his words, verified by his own personal observation of the subject on four continents, the greatest authority and power :

"There are parts of Asia Minor, of Northern Africa, of Greece, and even of Alpine Europe, where the operation of causes set in action by man has brought the face of the earth to a desolation almost as complete as that of the moon ; and though within that brief space of time men call the "historical period," they are known to have been covered with luxuriant woods, verdant pastures, and fertile meadows, they are now too far deteriorated to be reclaimable by man ; nor can they become again fitted for human use except through great geological changes, or other mysterious influences or agencies of which we have no present knowledge, and over which we have no prospective control.

"The earth is fast becoming an unfit home for its noblest inhabitant, and another era of equal human crime and human improvidence, and of like duration with that through which traces of that crime and improvidence extend, would reduce it to such a condition of impoverished productiveness, of shattered surface, of climatic excess, as to threaten the depravation, barbarism, and, perhaps, even extinction of the species.

"The destructive changes occasioned by the agency of man upon the flanks of the Alps, the Appenines, the Pyrenees, and other mountain ranges in central and southern Europe, and the progress of physical deterioration, have become so rapid that, in some localities, A SINGLE GENERATION HAS WITNESSED THE BEGINNING AND THE END of the melancholy revolution.

"It is certain that a desolation like that which has overwhelmed many once beautiful and fertile regions of Europe awaits an important part of the territory of the United States, unless prompt measures are taken to check the action of the destructive causes already in operation. It is in vain to expect that legislation can do anything effectual to arrest the progress of the evil, except so far as the State is still the proprietor of extensive forests. Both Clavé and Dunoyer agree that the preservation of the forests in France is practicable only by their transfer to the state, which alone can

protect them and secure their proper treatment. It is much to be feared that even this measure would be inadequate to save the forests of our American Union.

"There is little respect for public property in America, and the federal government certainly would not be the proper agent for this purpose. It proved itself unable to protect the live-oak woods of Florida, which were intended to be preserved for the use of the navy; and it more than once paid contractors a high price for timber stolen from its own forests.

"The only legal provisions from which anything can be hoped are such as shall make it a matter of private advantage to the landholder to spare the trees upon his ground, and promote the growth of the young wood. Something may be done by exempting standing forests from taxation, and by imposing taxes on wood felled for fuel or timber; something by premiums or honorary distinctions for judicious management of the woods. It would be difficult to induce governments, general or local, to make the necessary appropriations for such purposes. But there can be no doubt that it would be sound economy in the end."

Such are some of the thoughts and words of this eminent scholar, statesman, and observer, published after this company had been fully organized, and for years in contemplation. His whole book, "Man and Nature," bears testimony on every page to the existing wants and evils already upon us, and which make the action of the government an instant and imperative necessity. * * * * * * *

Hear G. P. Marsh, fortified by the ablest European writers, respecting the appropriate proportions between wooded and tilled lands, in order to secure the highest agricultural and healthful returns.

In 1750 Mirabeau estimated that there should be retained in France *thirty two per cent.* of the land in wood. The forest was destroyed, with the most disastrous effects upon the general prosperity, far faster than his estimate allowed, and the percentage was reduced far below that proportion. Marsh says: "It is evident that the proportion of forest in 1750, taking even Mirabeau's large estimate, was not very much too great for permanent maintenance, though doubtless the distribution was so unequal that it would have been sound policy *to fell* the woods *and clear land in some provinces*, while *large forests should have been planted in others.* During the period in question France neither exported manufactured wood nor rough timber, nor derived important collateral advantages of any sort from the destruction of her forests. She is consequently impoverished and crippled to the extent of the difference between what she actually possesses of wooded surface, and what she ought to have retained.

"Since writing the above paragraph, I found the view I have taken of this point confirmed by the careful investigations of Rentzsch, who estimates

the proper proportion of woodland to entire surface of *twenty-three* per cent. for the interior of Germany, and supposes that near the coast, where the air is supplied with humidity by evaporation from the sea, it might safely be reduced to *twenty* per cent. The due proportion in France would considerably exceed that for the German states.

"Now, if the German states require 23 per cent. midway between the North sea, the Baltic, and the Mediterranean, what is demanded for the great area between the Mississippi and the Rocky Mountains, almost without water from the Gulf of California to the Polar sea!"

WOOD PAYS MORE THAN ONE-HALF THE ENTIRE INTERNAL REVENUE OF THE UNITED STATES.

All wood that has been so used as to make it a part of man's real estate, or which is the staple of man's business as a manufacturer, is taxed as real estate or manufactured products. But all wood thus invested in any manner, where it pays to the owner an income, whether it is in movable or fixed form, is obliged, if he has an income of over six hundred dollars, to pay a second time on all that it has clearly produced him, except what he before paid as taxes. It is thus true that, in one form or the other, all standing timber, all lumber and wood used in houses, steamboats, or permanent instruments of any kind, and all that is used in industry or manufacturing, pays a tribute to the United States.

Let us take, then, the real estate of the United States:

In the erection of ordinary buildings of brick and stone—not cut-stone walls—and with wooden floors and joists, it is estimated that the cost of timbering, flooring, roofing, wainscotting, the finishing of entrances, cornices, cupolas, doors, window-sashes and blinds, make an expense for woodwork equal to at least that for all the brick and stone work. The woodwork, then, which represents not only the raw material, but the labor necessary to put it in its complete form and appropriate use, pays one-half of the tax accruing upon that improved property. And taxes are very light upon the same land, wherever situated, when without buildings, in comparison to what they are when it is improved. But we must go further back.

It required, if the building is one of brick, wood with which to burn the clay, making about one-third the expense of making the brick. In like manner the lime is burned with wood, and half its value arose from that expense. But the clay is in the bank, the rock is in the quarry, and wagons, made largely of wood, must carry the one to the kiln and the other to the pug-mill; and, when burned, the same wagon is needed to draw them from the kilns to the place of using. But then we have not got far enough back. The brick-maker the lime-burner, the stone-mason, the bricklayer, the plasterer, the painter, the carpenter, have all needed wood in their houses for

fuel, in their dwellings to shelter them, in their stables to protect their animals. But come to the building itself. Hogshead and lime box, a hod and a scraper, a mortar board and a pail, tressels and scaffolds, inclined planes and ladders, a plumb and a trowel—wood, wood, incessantly wood! Even for the mason the same for the plasterer, the painter the carpenter, everything he grasps to work with is, first of all, wood. Far more than one-half of all the value of ordinary brick and stone buildings in the United States has come from wood, and pays one-half the taxes. But we come to other buildings. There were in the United States in 1860, 3,362,337 dwelling-houses, besides all public buildings, churches, educational institutions, stores, manufactories, depots, warehouses, &c. How large a proportion of these were brick we cannot tell; but by far the great majority were of wood. And what proportion of their cost came from manufactured wood? A little hardware, a little paint, a little masonry, the plastering, and all else was wood. But let us estimate a little on farm-houses. When these are built of brick, the lime and brick are often burned with fuel cut on the very farm where the house is erected. The barns and out-houses, and the fences, are also generally constructed of wood. Now, if we assume that the houses, barns and fences give but one-half the value to the farm at which it is assessed, (which estimates the land unimproved as worth half as much as when thus improved,) then this astounding fact comes to our notice—the value of farms in the United States in 1860 was $6,654,045,700, and the value of the lumber improvements would be $3,322,522,000. This has been cut from our soil and put into these permanent improvements, and pays taxes.

Now the vast majority of these improvements have been made within the last thirty years, (probably twenty;) and as within that time, probably, old houses, barns, and fences have been replaced sufficient to make the whole amount new; during that period, on farms alone, there has been cut and used annually, and changed into permanent tax-paying property, $101,070,000 worth of forest. These improvements are continually growing old and falling into decay. But this is a single item. "A good barn will build a a good house," is an adage that thousands of farmers have proved true; the protection of crops, the defence of stock, the shelter of vehicles and implements, have saved thousands of dollars to many a farmer. How much of the income tax paid by the farmers of the nation represents the wood in their utensils, vehicles, barns, stables and fences, outside of the value assessed directly upon them?

But pass a moment to manufactures. The cotton manufactures are the second in the United States, as reported in the census for 1860, the products being $115,137,926; the value of flour and grist mill products being the first, and amounting to $223,144,369. Let us now take lumber, and contrast

it with these. There was of sawed and planed lumber in 1860, $96,000,000 worth. The products of the grist-mills furnished occupation to 19,000 bakers, besides being used in every household supplied by the baker. The products of the cotton-mills, besides the private use in families, in part, gave employment to 90,000 seamstresses and 102,000 tailors and tailoresses. But as one-half the labor of these was expended on woolen, silk, or linen fabrics, it gave direct employment to about 96,000 men and women. Now the direct tax on the produced timber was almost as great as on the cotton goods, while in the line of furnishing employment to others in the simple trade of carpentry alone, employing only men, it gave business to 242,958, or nearly three times as many as worked in cotton, and thirteen times as many as worked in flour and meal.

The iron interest and the machinery interest (often requiring much lumber) are immense, but the pig iron in 1860 amounted to only $19,487,790, and the bar and other rolled iron to $22,248,796, making a total of $41,736,586. The machinery made in this country in 1860 amounted in value to $47,118,550, and of sewing machines to $5,605,345, making a total of iron produced and machinery manufactured in 1860 of $94,460,481—a million and a half dollars less than the raw lumber of the country which had passed through the saw-mill.

I have before said that there are sixty-six trades in whole or in part dependent upon wood as their material for manufacturing. What they can earn or do earn cannot be known; but two points will help us to approximate. There were 29,223 cabinet-makers, who produced $22,701,304 worth of ware; also 3,510 piano-makers, musical-instrument makers and organ-builders, who made $5,791,807 worth of musical instruments. If we should average these two trades, we should certainly set our mark too high, as one is low, and the other unusually high, demanding skilled labor. The production *per capita* above was, in the first, $771, in the other, $1,651. Should we estimate the production of those 476,623 artisans in wood at $1,000 each, we should have nearly $500,000,000 per annum, of which scarcely a trifle, excepting the two items above of about $28,000,000, appears in any column of the census. This is additional to the making of the lumber itself. From all incomes over $600 the United States exacts a tax.

United States buildings, capitols, and public buildings belonging to the respective States, and all educational institutions and county property, and, generally, churches, are exempted from taxation, and therefore are of no value under this particular point of revenue, although, if they are of such vast importance, subserve such necessary and useful purposes, and are paid for by the money of the people generally, their wood pays its tribute to the maintenance of the government, the dispensing of justice, and the diffusion of religious truth and influence through the nation.

CARBOLIC ACID AS A DISINFECTANT.

The North British Review, No. LXXXVIII., has an important article on *Disinfection*, in which the writer discusses the effects of carbolic acid as a means of preserving animal and vegetable substances. The following extract will suffice to show the author's view of the importance of this substance in its relation to the arts and to medicine. It also involves a very strong scientific indorsement of the great value of our method of preserving wood:

Carbolic Acid.—Heat is compound in its action, cold is purely colytic. There is another action of pure colysis, so far as we know, in *carbolic acid.* We feel inclined to go back to the ancients, when speaking of this substance. The Egyptians, as we find in Hoefer's *History of Chemistry*, used oil of cedar, which he calls turpentine. We are inclined to think that it was not true turpentine, which is not a very good agent in enbalming, and we think rather that it was a very mixed tar-oil, and would contain the tar acids. Ancient Egypt wrote little for us, but we find in Pliny such an account of the manufacture of oils as a literary man would write. The tar was boiled, and the fleeces of sheep held over it, in order to collect the less volatile oils. The naphthas, by this process, would be lost. The distillation must have been carried very far, as there was obtained a reddish pitch, very clammy, and much fatter than other pitch. This was the anthracene, chrysene, and pyrene of later times.

The remainder was the *palimpissa*, or second pitch,—what we call pitch, as distinguished from tar. Sometimes this name was given to the substance obtained by distillation; a good deal of confusion, therefore, is caused. The product in the fleece would contain the heavy oils, and with them the carbolic acid (phenic acid, or alcohol). It was called *picenum pissenum or pisselæum;* that is, pitch or tar oil, as we call the crude product now. They used it for toothache, as we use it still, and for skin diseases of cattle, which we are beginning to do also. Hams were also smoked by hanging them on the roof, above the fires.*

Runge called the creosote from coal, carbolic acid, or coal-oil. It really has acid properties, but its composition is analogous to alcohols; and it is strange that several bodies of that constitution should have so much power of preventing putrefaction. Reichenbach obtained it among his many new bodies, which people could not find till long after he did. Alcohol, common methylated spirit, fusel oil, carbolic acid, and cresylic acid, which latter is found in the distillation from coals, are all anti-septic. Carbolic acid is

* This and other allusions from Lecture on Disinfection, *Society of Arts Journal*, 1857.

found in the products of distillation of wood, of benzoin resin used in fumigation. It is even found, according to some, in animal secretions. The tar-barrels burnt in the time of epidemics, from the earliest date till this year, give out this acid, but would give out more if the flame were suppressed, and distillation only allowed. The world has admired this substance without knowing its existence, and sought it in every corner, using various names to express it, wrapping it in bundles to carry around them, burning it in pastilles for fumigation, and sometimes in public in great bonfires. Savages use petroleum for their wounds and their cattle, and the most civilized of old times kept in products of tar the dead that they desired to preserve to a joyful rising. Bishop Berkeley tells us that it was used as tar-water in America, the tar being merely stirred up with the water, and the water drunk, a glass at a time. He himself had tried it in many diseases, and tells us of small-pox, erysipelas, skin diseases, and ulcers, being cured by it; quotes the pitching of wines by the Romans as a proof of its value, and Jonstonus, in his *Dendographia*, as saying that it is wholesome to walk in groves of pine-trees, which impregnate the air with balsamic particles. The learned writer then goes on to say that, although he may be ridiculed, he suspects tar-water is a panacea; "and as the old philosopher cried aloud from the house-tops to his fellow-citizens, '*Educate your children;*' so I confess, if I had situation high enough, and a voice loud enough, I would cry out to all the valetudinarians upon earth, Drink tar-water." What, then, is the wonderful agent after which men have hunted in tar-water? Like all such hopes of men, it becomes less when it is found, but it is still of great value. It is not one thing only, there are many things to be found. We have the tar acids and turpentine, benzole, aniline, acetic acid, and many other things from tar, and each has its place.

Of these substances from tar, carbolic acid has taken the lead. It will be seen that its chief properties were examined by chemists some years ago. Not to go further back than Gmelin's Chemistry, or, still earlier, 1843, Liebig's edition of Geiger's Chemistry, the crystals melt between 34° and 35° Cent., the liquid boils at 187°, is oily, and resembles in smell creosote, burns the skin, which peels off, coagulates blood, but does not stop bleeding; sp. g. 1062 at 20° C.; burns with smoke, decomposed by chlorine and bromine, gives picric acid when treated with nitric acid. "The relation of carbolic acid to organic substances is very interesting," etc. A solution saturated destroys plants rapidly; coagulates blood; is very hurtful if allowed to touch the eyes; leeches and fishes die in it without convulsions; animals dry up without decomposing; weak solutions of gelatine are not made turbid by it, but strong are; albumen it coagulates to a mass soluble in excess of albumen.

Skins treated with lime become, in a solution of carbolic acid, horny and

transparent; laid in water they become soft and slippery, like fresh skins, but don't again become foul. Putrid flesh loses its smell at once; so with excrements. The acid combines with the substance.

Speaking of creosote, Gmelin says water with 1 in 10,000 smells of smoke. Its most wonderful property is its preservation of flesh. It stops flow of blood. It kills beasts, fishes, and insects. Plants are killed, and, like animal substances, preserved from decay. Liebig says also that it was used long before Reichenbach discovered it, as *aqua Binelli*, kept a secret in Italy. The *aqua empyreumatica* of Silesia contained some of it, made by distilling crude wood vinegar with lime.

Lemaire, in his book *De l'Acide Phénique*, 1865, gives numerous details, and shows fully the truth of the earlier observations, with much additional matter. It has been supposed that its power to stop decomposition is the same as its power of coagulating albumen; but a solution of 1 in 1000 of water will not coagulate albumen, while it prevents fermentation of sugar, and also putrefaction in certain conditions.

So thoroughly has the belief in tar gained ground, that it ranks among the firmest superstitions of the world. There are people now who expect to remove the cattle-plague by marking a cross with it on the wall before the nostrils of their cattle; and when we read Lemaire's book—by a scientific man who leans on facts—we find him scarcely less enthusiastic than Berkeley himself. We must remember that, although the latter had not modern training in science, he was a man of genius.

There is neither life nor decay without motion.

Tar acids arrest that motion which takes place in decay. They therefore are antiseptic; they antisept. As soon as the decay ceases, the putrid gases cease to arise. Tar acids are therefore disinfectant. They prevent oxidation, but not of inorganic substances. They don't prevent iron from rusting. The movements there required are too powerful; but in organic substances there is more yielding, and there carbolic acid shows its influence by preventing their oxidation. Mr. Crookes, in his report, says that it may be looked on as distinguishing vital phenomena from those purely physical. Pettenkofer, on the other hand, finds that although it arrests fermentation, the ferment preserves its power, and acts when the carbolic acid is gone. Such a result can only occur when the acid is used weak. At Carlisle, the use of carbolic acid has been employed for years, preventing rot, and preventing the growth of all unpleasant decomposition, so common in soils heavily manured. This leads us to a curious point. It would appear that we can apply such graduated amounts as will arrest putrefaction, which we may call lower organic phenomena, or destroy the vital power entirely. We can then proceed to destroy the higher vegetable and noxious animal life.

CHAMPOLLION ON EMBALMING.

It is a well known fact that human bodies, linen fabrics, and wooden sarcofagi, were treated by processes known to ancient Egyptians, which preserved them for thousands of years. In the work on Ancient Egypt, pages 260–262, will be found descriptions of the various modes of embalming. But by the process referred to in the following extract, it will be seen that the principal preservative material used was the same as that employed in the "Robbins Process." Champollion says:

"The first operation of the embalmers consisted in extracting the brain through the nostrils by means of a bent instrument; the cavity of the head was then filled by an injection of liquid of very pure bitumen, which hardened in growing cold. The covering of the brain has been taken from the heads of mummies in a state of perfect preservation. . . . . .

"Often, instead of drying the body, they injected into all the veins, by a very complicated and costly process, a liquor chemically prepared, which had the property of preserving the body and leaving its members almost all their natural elasticity.

"The intestines and the principal viscera were submitted to a preparation of *boiling bitumen*. The brain, the heart, and the liver were enveloped separately in a piece of linen, and deposited in four vases which were filled with the same *bituminous substance rendered liquid by fire*." After a full description of the manner in which the bodies were then bandaged, decorated, &c., the author says, "It appears also from the condition of some mummies, that after the preparations, they were plunged all dressed into a vat of boiling bitumen, which penetrated them even to the marrow of the bones."

FROM A MEMBER OF THE N. Y. HISTORICAL SOCIETY.

New York, *July* 25, 1867.

To J. Richard Barret, *President National Wood Preserving Company.*

Dear Sir,—In reply to your note, containing inquiries regarding the Preservation of Wood, etc., etc., by the ancients, I have to say, that centuries ago, when the banks of the Nile became so densely populated, and the

forests of Northern Africa disappeared and were converted to the uses of civilization, it became necessary to adopt some means to preserve all articles that were composed of wood from mould or decay. Wood became valuable; the demand for it was imperative. How long it required to bring the processes of preservation to perfection, it is now impossible to find out; but that the Egyptians had a process, and that they did preserve wood and many other perishable things, for thousands of years, there is no doubt.

In the New York Historical Society, corner of Second Avenue and Eleventh Street—which contains the Egyptian Museum—can be seen WOOD WHICH IS OVER FOUR THOUSAND YEARS OLD; also linen, towels, robes, ropes, canvas, paper, and numerous household articles and implements, all of which have been preserved and are now in good condition; so that whatever may be said, as to what can or cannot be done in this age, we have the incontrovertible fact before us, that wood *has been* preserved FOR OVER FORTY CENTURIES.

The preservative arts were carried to great perfection by the Egyptians, but were known only by the learned, and sacredly guarded as important secrets. When the decadence of the Pharaoh's began, and the waves of barbaric invasion swept over that cultivated people, the preservative arts, and many others were lost in the darkness of the centuries that followed.

The tombs that overlook the waters of the mysterious Nile, became the repositories of all that was earthly of the Egyptians. In the palaces of the dead were the archives of the nation; they were sealed and remained so for ages. The traveler and antiquarian at last entered their sacred halls, and made discoveries that must be of great benefit to mankind. Not the least among these was the fact that *wood could be preserved for ages.* From a careful and minute examination of the different articles now in the Egyptian Museum, we feel confident that the means used to preserve them consisted in permeating them with asphaltic or oleagenous vapors.

The vast consumption, waste and decay of wood in this country, have already admonished our people that we too must follow the example of older nations in the preservation of articles of absolute necessity, as well as those things upon which time, labor and money have been expended.

To rediscover the lost arts of the ancients, has for years occupied the attention of the first minds of the old world; but it seems to have been reserved for an American to discover and apply practically one of the most important.

It is a remarkable fact that all the articles at the museum have the same dark brown appearance, and are strongly impregnated with creosote and asphaltum. Viewed under a magnifying lens, they present every evidence of having been permeated with vapor. If this be so, the Robbins process

will prove to be no less than the discovery of the lost art of preservation as practiced by the ancient Egyptians; and as time advances, and wood becomes scarcer, this discovery must increase in value and importance.

Yours truly, J. W. M.

WOODEN PAVEMENTS.

In our principal cities there is a growing disposition to adopt wood in the place of stone and iron for pavements. But two weighty objections have been urged against the general adoption of the wooden pavements heretofore employed; and these are based on the perishable nature of such pavements and their influence on the atmospheric conditions of health. These objections are, however, completely obviated by the application of the National Wood Preserving Company's method—known as the "Robbins Process"—in the treatment of the blocks. The vaporized elements of carbolic acid and creosote, with which the wood is thoroughly impregnated, are the most effectual of all known disinfectants; and it is especially worthy of observation, that they never lose their preservative power, but continue to be operative for an indefinite period. (See the preceding article from the North British Review.)

This treatment not only preserves the wood from decay, but it hardens it, cementing the fibers together, and rendering it capable of resisting every form of compression and abrasion in an extraordinary degree. It is only necessary to prepare wooden pavements by this method and our great cities may be constantly fortified against pestilence. The most powerful antiseptics and disinfectants will be everywhere diffused through, and will remain in, the very pavements of our streets, until the same are literally worn out.

THE SANITARY QUESTION.

From the Hartford (Conn.) Daily Times, of June 20, 1867.

We perceive that an important communication has been made to the Board of Health of New York, by Prof. S. B. BRITTAN, M. D., who represents to that body, that the general adoption of wooden pavements—*unless they are suitably prepared by some chemical treatment that will coagulate the albumen of the sap*—would seriously endanger the public health. Dr. Brittan is known in this country and in Europe, as the author of an elaborate treatise on the physiological and metaphysical philosophy of human nature. His scientific expositions of the influence of subtile agents on the atmospheric conditions of health, and on the organic functions of living beings, have attracted the attention of learned men in both hemispheres. It was but natural, therefore, that his communication to the Board of Health should be referred to the Sanitary Committee.

From the following, which we find in the *Herald* and *Tribune* of a recent date, it will be perceived that Dr. Stone, from the Sanitary Committee, made a report, fully concurring in the opinion of Professor Brittan, in respect to the dangerous tendency of the present wooden pavements—if generally adopted—and requesting the further reference of Dr. Brittan's communication to His Honor the Mayor :

"Dr. Stone, from the Sanitary Committee, to whom had been referred the communication of Dr. Brittan on the unhealthfulness of wooden pavements, reported that they were deleterious to the public health unless permeated by some chemical substance to coagulate the albumen in the wood, to prevent its decay ; and requested that Dr. Brittan's communication be referred to His Honor the Mayor for his consideration. The communication was so referred."

A friend who is familiar with the proceedings of the Metropolitan Board of Health has furnished us with the material portions of the letter addressed to Jackson S. Schultz, President of the Board.

EXTRACT FROM PROFESSOR BRITTAN'S LETTER.

Before we conclude to adopt this (the Nicholson) or any other wooden pavement, two very important questions should be definitely settled. First, can a pavement made of wood be rendered sufficiently durable to warrant our laying it down in the principal thoroughfares of a great commercial city. When wood is exposed to all the changes of temperature and degrees of moisture, it will decay within five years. A single rotten piece of timber may, moreover, be sufficient to impair or destroy the integrity of the whole superstructure to which it belongs. In respect to pavements, a few decayed blocks make it necessary to disfigure the surface and to inter-

rupt the travel on the street. After two or three years wear the damaged blocks must be removed and others substituted, and the occasion for such repairs become, in every succeeding year, more frequent and imperative.

Nearly thirty years ago wooden pavements were tried in this city and Boston. In the last named place the citizens objected that the immense quantity of moisture absorbed in wet weather, and exhaled under the action of the sun's rays, rendered the atmosphere unwholesome, and even dampened the merchandize in the stores. At length, owing to the determined opposition of merchants and other property owners, the wooden pavements were taken up and never replaced. In this city the early experiments were scarcely more satisfactory. For a quarter of a century no further attempts were made to pave the city with wood.

The block pavements of that early period may have been inferior to the Nicolson pavement, in respect to *structure*, but certainly not in the inherent durability of the wood. Mechanical perfection, however, avails little or nothing when the materials of which the structure is composed are intrinsically frail or necessarily perishable. The public mind has of late been constantly occupied with some *structural device*, and in this way it has been diverted from the graver question that relates to the durability of such pavements. While this is of fundamental importance, the mechanical feature is comparatively of little moment.

But a question of still more vital importance remains to be satisfactorily disposed of before we can consent to the general use of wood pavements. *How is the public health likely to be affected?* This question does not merely interest private capitalists and public contractors; it deeply concerns the whole community. In this case my observations have led to very definite conclusions, and these are all adverse to the adoption of wood for pavements, unless it can be so prepared as to obviate the main objection. Every well-informed person is aware that large masses of decaying vegetable matter destroy the necessary conditions of health, so far as these depend on the state of the atmosphere. If New York were wholly built of wood, and the outer surfaces of the buildings left without paint, the city would inevitably become pestilential. It is a mistake to suppose that the atmospheric conditions of health can be preserved even while the fibrous portions of the wood remain sound. Long before the ligneous part of the wood is visibly impaired the albuminous elements putrify, and as often as moisture is absorbed from the atmosphere, in any considerable quantity, it is exhaled, not in a pure state, but combined with more or less albumen in a putrescent condition. This contaminates the air we breathe and the conditions of health are thus interrupted. This must inevitably follow the paving of the city with wood, unless it be first prepared by some chemical or other process that will prevent decay and change the ordinary conditions of its elements.

The partial or complete application of coal tar, in a crude state, to the outside of blocks will not accomplish the object. This superficial treatment does nothing to coagulate the albumen, or to otherwise render it insoluble in water. The most essential conditions of decay all remain and must be removed by some other and more radical method. To render the adoption of wooden pavements compatible with the public health, *the blocks must be thoroughly permeated by some agent that will at once produce a complete coagulation of the albumen and protect the fibre from moisture.* If an agent can be selected that will, at the same time, serve the city as a constant and powerful disinfectant, a great object will have been gained by the substitution of wooden pavements in the place of stone and iron.

In the forests, Nature shades the surface of the ground, so that the process of vegetable decomposition, even in summer, is not materially accelerated by exposure to the sun. On the contrary, a vast woodland, in the shape of street pavements in a state of decay, covering one-third of the whole area of the city, and constantly exposed to the alternations of rain and sunshine, will soon fill the whole atmosphere with a pestilential malaria, consisting of the putrid albuminous exhalations from a dead forest. This would render the island a charnel house.

It is said that the materials and the process employed by Mr. Robbins to which we have heretofore referred in the *Times*, meet all the requirements in respect to health, the substances used in the preparation of the wood being in themselves powerful disinfectants. If the natural process of decay can be prevented, and especially if we can have the means of protection against pestilence infused into and through the very pavements of our streets, the public should know it, and make haste to adopt the improvement.

HEALTH IN THE PAVEMENTS.

CERTAIN parties interested in the Nicolson pavement assume that coal tar, applied to the surface of the blocks, answers every purpose, as a disinfectant, that can be accomplished by the use of the best products obtained by its distillation. This is a very grave mistake, that has its origin either in a blind devotion to personal interests, indifference to the public welfare, or otherwise in utter ignorance of the scientific facts in the case.

The chief antiseptic and disinfectant elements of the tar

are known as creosote and carbolic acid. These can only be eliminated by the application of the requisite degree of heat and the process of distillation. While these are united with all the other and heavier constituents of the tar, they are quite inactive, and, of necessity, in this crude form can only produce a *surface effect*, which leaves the work of organic and chemical decomposition to go on within. To claim anything more or better than this as the result of such a treatment, is an unwarrantable assumption. It must be obvious that the beneficial effects of the greatest known disinfectant—carbolic acid—can never be obtained by merely besmearing the outside of the blocks with tar. Indeed, the article known as carbolic acid does not exist, in fact, until it is formed by disengaging and uniting certain gases in the process of distillation.

When wood is treated under the Robbins patent the preservative elements of carbolic acid and creosote—which are disengaged or generated in and by the process of distillation—act directly and with all their force on the chemical constituents of the wood, so as at once to arrest and forever prevent albuminous fermentation. At the same time the fibrous portions of the wood are completely oiled in such a manner as to protect the same from moisture.

The conference of medical men recently assembled at Weimar, to consider the subject of Cholera, its causes and the method of its treatment, recorded their unequivocal testimony in favor of carbolic acid as a disinfectant, and as a means of arresting and preventing that fatal disease. We copy

From the New York World of July 12, 1867.

The attendants at the conference were from various cities of Germany, Holland, Prussia, Austria, Hungary and Russia. Their discussions were based upon the experience and studies of the distinguished gentlemen who

had thus agreed to meet and compare their views and the results of their observation.

The conference expresses, as its deliberate conviction, that the efforts to arrest and prevent cholera by disinfectants should be continued in the most energetic manner, and they recommend the use of carbolic acid as the best and cheapest article to be used. In the report of this conference it is stated that Professors Klob and Thome have discovered a minute microscopical growth that seems thus far to be exclusively produced in cholera excrements. The spores of that little growth, multiply with marvelous rapidity, and they are not destroyed by ordinary doses of chlorine or chloride of lime, but are killed by carbolic acid.

RELATIVE WEAR OF DIFFERENT PAVEMENTS.

FROM CARRIAGE-WHEELS AND HORSES' SHOES.

We are indebted to Mr. Fisher, a well-known engineer, artist and journalist of this City, for the following communication which will be read with interest in this connection. In the light of his statement it will appear, that the general adoption of a permanent wooden pavement would involve a vast saving in horse-shoes and carriage-tires, and also in the labor of cleaning the streets. Of course the saving of horse *flesh* and in vehicles, generally, would be vastly greater, and scarcely to be estimated.

Macneil weighed the shoes of horses and the tires of stages and wagons, when new, and after they were worn out on Macadam roads. While the shoes of the horses of a stage lost 1000 lbs., the tires lost but 326·8 lbs., or less than a third as much; and while the tires of a wagon, in traveling 6,048 miles, lost 309 lbs., the shoes of its horses lost 360 lbs. He considered that the wear of roads by the wheels and the feet, respectively, was about in proportion to the wear of the iron; and that stage-horses wear the roads three times as much as the stages, and wagon-horses wear the roads one and a quarter times as much as the wagons. On pavements the proportions were different: while a cab, weighing 1,050 lbs., wore a certain weight of iron from its tires, seven times as much as was worn from its horses' shoes.

Analyses were made of the sweepings of Macadam roads and stone and wood pavements in London, by which it was proved that on Macadam one-ninth of the dirt was manure; on stone pavements one-third was manure;

and on wood pavements it was considered all manure, and readily paid for as such by farmers. The wear of shoes and tires on the wood was slight, but was not accurately measured; enough, however, was shown to prove that wood pavements are much cleanlier than stone—probably the dirt from them is about a third as much as that from granite pavements, such as are much used in London, and such as that now being laid in Broadway.

Noise, vibration of buildings, etc., much less. It should be recollected by stage-owners, whether horses slipped on the wood pavements we had here thirty years ago. In London they slipped where it was hilly; but London is more hilly and more wet than New York. If they will not slip on blocks that fit together, Nicolson's method of setting them an inch apart, with gravel between them, is worse than useless: it makes more rumbling, costs more, and makes a less durable pavement, and imposes a royalty, and prevents free competition in paving.

THE MOST USEFUL DISINFECTANT:

From the Scientific American of Sept. 8, 1866.

Carbolic acid has lately come to be a great favorite as a disinfectant. Where its virtues are best known it is more relied on than anything else as a preventive of cholera. There are those who think that if it were liberally used wherever there is unhealthy organic decomposition, miasmatic diseases would soon become unknown. Our very efficient Board of Health, we observe, have added it to their list of disinfectants, and are using it on a large scale. At the next cholera season we predict that it will be better known and be more valued than any other disinfectant.

The reasons why carbolic acid is such an admirable disinfectant are easily to be understood. Miasmatic matter, and almost everything contained in the air which is offensive to the senses, are the products of the fermentation or the putrefaction of organic matter. Now, it has been found that carbolic acid is the sovereign and never-failing anti-putrescent and antiseptic. The power of carbolic acid is wonderful for its promptness and its persistence. Putrefaction can neither go on nor be commenced in its presence; it preserves everything *in statu quo*. It is certain that several organic poisons act like a ferment, or are matter in the state of decomposition. Mr. Crookes has shown that the virus of the rinderpest is of this character, and it has long been surmised that the virus of serpents and of contagious diseases belong to the same category. In all these cases, wherever carbolic acid can be applied, it may prove to be a specific.

Chloride of lime acts very promptly as a deodorizer of the air, and to this fact it owes its high reputation. It destroys noxious matter by bring-

ing about a chemical change in it. It enters into chemical union with some part of it, and no longer exists in a state to do more useful work; it is exhausted in doing its work; it is wholly used up. Moreover, chlorine acts by reason of its affinity for hydrogen; and as hydrogen is an element of innocuous matter, it wastes much of its energy where it is not needed. It deodorizes promptly, but where is the evidence that the virus has a foul odor? How do we know that anything beyond the odor is destroyed?

Carbolic acid, on the other hand, goes to the root of the matter. It acts as a preventive. It destroys our enemy in the egg. No noxious effluvia can come from the matter with which it is in contact. It mixes kindly with everything. A very remarkable fact about it is, that in doing its work, there is no chemical change. It remains always free carbolic acid, and the matter with which it is surrounded continues the same as at the first instant of contact. Thus the carbolic acid is never consumed, and may continue forever its office of restraining the demon.

Two simple experiments illustrate the peculiarities of chlorine and carbolic acid. Bring a piece of putrid meat into an atmosphere of chlorine and it comes out sweet. But wait. Observe that it is only the fetid atmosphere about the meat which was affected; let this be blown away, and a new one takes its place. Let the meat be now dipped in a weak solution of carbolic acid and exposed to a current of air. The foul odor is soon blown away, and the meat may continue sweet forever.

Carbolic acid is cheap, and is applicable under circumstances where anything else would be impracticable or objectionable. Thus it may be dissolved in the water used in sprinkling the streets, and relieve us from that peculiar city effluvium which is so noticeable and sickening to those who have just come out of the pure air of the country. It may be used in the washing of the clothing, bedding, etc., of infected persons. It is perfectly safe to be used in the family.

PRESERVATION OF WOOD FROM DECAY.

Correspondence of the Scientific American.

MESSRS. EDITORS:—In some respects I fully agree with your correspondent as to charring wood.* The advantages of charring a post do not consist, as scientific men have supposed, in the capacity of charcoal to absorb the gases from decaying substances. But the application of heat, to such an extent as to create charcoal on the outside of wood, will drive out the surface moisture and coagulate the albumen of the sap, and render it insoluble in water. While this treatment, as a seasoning process, is of great

* See *Scientific American* of Sept. 15, 1866.

benefit, no one at this day will contend that it is essential to the preservation of wood. Neither Kyan, Burnett, Payne, Boucherie, Bethell nor Robbins, ever charred wood, in order to preserve it. Still, in my opinion, a certain degree of heat is necessary, if it be properly applied, and with it and through it vapors may be infused into wood, which will render it indestructible.

But your correspondent asserts that the microscope reveals the cause of decay in wood as due to parasites feeding upon albuminous substances, and he recommends the use of hot air or superheated steam as a means of destroying the parasitic germs or albuminoids, which, he says, cause the decay of wood. This idea raises several important questions for consideration.

First, Are the parasites the cause of decay in wood?

In botany we learn that a parasite is a plant without the proper organic means or instruments to enable it to draw its nourishment directly from the unorganized elements, but which derives its support from other plants to which it attaches itself. In entomology and zoology the parasite is represented as some insect or minute animal which lives on the superior forms of animated nature. According to Ehrenberg and other scientific authorities, while these creatures exist wherever organized matter is undergoing decomposition, it does not appear that the decomposing process is due to their presence. "Wherever organic matter exists in a decomposing state, there they abound, acting as scavengers in devouring, in the state of comminution and decay, those particles of decomposing matter which, if left to be diffused throughout the atmosphere, might be productive of the most pernicious malaria." (See Ehrenberg and Leeuwenhock; also Redfield's "Nature in Living Forms," p. 690.)

Brande, in his "Encyclopedia," says, It is not certain that dry rot is caused by parasites; on the contrary the terms are applied to "spontaneous decomposition without the presence of fungi;" or where these parasites appear long after the commencement of the disease in the wood. We doubtless mistake the effect for the cause when we assume that parasites produce the decay of vegetable and animal substances. It would rather seem that they are generated in and are a product of the process of decomposition, and they live but to consume and assimilate those elements which would render the earth and air unsuited to the essential conditions of health and life. To this end, according to Ehrenberg, they multiply at the rate of millions daily. If the parasites had any active or vital existence before the albumen of the wood was in a state of putrefaction, they might possibly be destroyed, to some extent, by the application of heat or some other means. But they are chiefly distinguishable after the process of decomposition has fairly commenced. They are only found in animal and vegetable infusions after the same have been kept a sufficient time to develop their existence in and

through the decomposition of such substances. (Orr's "Circle of the Sciences," vol. i. p. 87.) Parasites may, therefore, be regarded as a result, and not as the cause of decay in wood.

Second, Can these parasites be destroyed by the application of heat, as proposed?

We are assured by the best authorities that the polygastic infusoria are very tenacious of life; while they are injuriously affected by strong poisons, they are capable of enduring great extremes of heat and cold, and are found alike beneath the snows of the highest peaks of the Alps, and in the hot springs that perpetually boil from the heat of volcanic fires. (Redfield's "Zoological Science.")

But for the sake of argument let us suppose that the parasites, parasitic germs, or albuminoids may be destroyed by heat; will not the wood, after they have been destroyed, be again infested with new and similar formations which will be equally destructive? These germs exist in water and in the air, as well as in organized substances, and may be readily deposited on the surface and in the pores of the wood, even after it has been subjected to superheated steam. If vegetable decomposition is due to the presence and action of the parasites, heat can protect the wood from their influence no longer than it is subjected to the temperature requisite for their destruction. As soon as it is exposed to air and moisture, at ordinary temperatures, parasites may be again developed, and very rapidly; for, according to Ehrenberg, the *hydatina seta* increased in twelve days to sixteen millions, and another species in four days to one hundred and seventy billions. Besides, scientific experiments have already fully established the fact that any infusion of vegetable or animal substance may be boiled for hours, and if subsequently exposed to the atmosphere, it will soon swarm with myriads of microscopic creatures. * By placing the wood in an exhausted receiver and thus excluding the air and establishing a condition incompatible with the laws which determine their existence, this regeneration or re-formation of parasites may be prevented. So it might be prevented by the continued application of heat at the boiling point, or at a sufficiently destructive degree of temperature. It is very evident that wood which has been treated with heat only, when no longer under its influence and not protected by an exhausted receiver, may, by exposure to the oxygen and moisture of the atmosphere, be in a short time covered on the surface and have its pores filled with infinitesimal germs and forms of life which may cause it to decay.

But suppose it is true that the parasitic germs or albuminoids are coexistent with the wood, that they are the cause and not the result of decay, the next question of importance is, how can they be destroyed, and their

* Orr's "Circle of the Sciences," vol. ii, p. 217.

re-formation and re-infestment prevented in the cheapest and most effectual manner?

The application of heat, simply, either in hot air or in superheated steam, may destroy them, as your correspondent claims, and it will also coagulate the albumen of the sap, etc., but it cannot protect the fiber against the effect of oxygen and moisture, nor can it prevent the regeneration or re-attachment of the parasites after the wood is again exposed to the air. Besides, this treatment will empty the pores to some extent and leave the ligneous fiber unprotected. The capillary tubes, being left open and exhausted of the vital elements of the living tree, will readily take up an increased quantity of water. This water will escape by evaporation when the wood is exposed to the action of the sun. And by the constant vicissitudes of temperature and the ever-varying degrees of moisture, the elasticity of the fiber will be diminished, and in time the integrity of the wood destroyed.

Hence it is that the celebrated Dr. Ure, in his Dictionary of the Arts, affirms, that "although the albumen contained in the sap of the wood is the most liable and the first to putrefy, yet the ligneous fiber itself, after it has been deprived of all sap, will, when exposed in a warm, damp situation, rot and crumble into dust. To preserve wood, therefore, that will be much exposed to the weather, it is not only necessary that the sap should be coagulated, but that the fibers should be protected from moisture." This necessity of further protecting the wood from atmospheric influence, after the albumen has been coagulated, becomes greater if, according to the theory of your correspondent, decay is caused by parasites, which the atmosphere furnishes so abundantly. Now the question recurs, and your correspondent has done well in raising it, What is the best means of driving out the surface moisture, of coagulating the albumen, of destroying the parasites, parasitic germs, or albuminoids, and of preventing all parasitic influence upon the wood thereafter?

In one of your issues of February I saw a very able article upon the process of preserving wood, invented by our American genius, Louis S. Robbins. According to my recollection, he proposes the use of coal tar and other oleaginous substances in vapor. It seems to me that these vapors will be found as hot as hot air or as superheated steam, that they will permeate the wood as readily, and more effectually destroy the parasites, parasitic germs, or the albuminoids referred to.

Now, coal tar is about thirty per cent creosote—which, as its very name imports, is an antiseptic, that is, preservative against putrefaction and decay. This creosote, in superheated vapor, will permeate the wood thoroughly, and destroy, not only by its heat but by its inherent poison, all the destructive parasites and other infusoria, and, at the same time, prevent putrefac-

tion, and, besides, the wood, being thus saturated with a deadly poison, will be protected against any attack from the parasitic infusoria which might originate after the treatment.

Then, by the heavier oils eliminated by distillation, the wood is saturated and completely primed, and the fiber is thus protected from the oxygen and moisture of the atmosphere, as recommended by Dr. Ure. The ancients were accustomed to preserve both vegetable and animal forms and substances by a process that rendered them so far imperishable that many of them, in spite of parasites, have come down to us in a surprising state of preservation. Specimens may be found in museums of Egyptian and other antiquities, in which even three thousand years have neither obliterated the outlines of mortality, nor destroyed the cerements that inclose them. They employed bituminous substances in their embalming or preserving process, and, as we believe, in the shape of vapor, while others have vainly attempted the same results with metallic solutions. Bethell, of England, and Louis S. Robbins, the American inventor, are the only two who have resorted to the application of bituminous substances, Bethell using them in liquid form, while Robbins applies them more effectually in the shape of vapor.

So far as we are able to judge, the process of Mr. Robbins is the nearest approach to the treatment resorted to by the ancients.

New York, Sept. 20, 1866.

HOW TO REMEDY THE EVIL.

From the Hartford "Daily Times" of June 21, 1867.

In a congressional debate which occurred last year, on the Canadian Trade Bill—the proposed duty on lumber being the special topic—Mr. Banks of Massachusetts took occasion to show that, while *shelter is the first necessity of man*, the business of building is comparatively suspended in New England, owing chiefly to the high prices of lumber. Now, as any duty that may be imposed on building materials, imported from other countries and their American dependencies, can only serve to advance prices here, it follows that the fundamental difficulty can never be obviated by a tariff on foreign lumber.

From a partial examination of the facts in this case we incline to the opinion, that our neighbors in British America would render us a great and lasting service by sending us all their surplus lumber. It is a short-sighted political economy that would impose any restraints upon its importation. We shall soon want supplies from abroad. Our native forests are being rapidly swept away, and hitherto no wise measures have been either adopted or suggested to stay the work of destruction. Have we no profound

political economists among us ; and are there no philosophical legislators in the country, who are competent to look at a great question in the light of essential principles and inevitable results? Unless some comprehensive measures are speedily adopted to preserve and augment our resources, we may as well be prepared for a still further advance in the prices of every species of wood that is at all suitable for mechanical purposes.

It is idle to stop or to embarrass the importation of lumber if we wish to reduce the standard of value in our own markets. We might as well blow up the foreign coal mines with the expectation of lowering the market value of fuel. Every resource that is cut off, no matter by what means, only lessens our supplies while it does nothing to diminish our necessities. Such evils as the one complained of by Mr. Banks, require more radical remedies and a more rational treatment than is proposed and practiced by the congressional tinkers of the tariff.

If the claims put forward by the National Wood Preserving Company have a substantial basis in reality, as we are strongly inclined to believe, they suggest an easy and satisfactory solution of a difficult question. The remedy for the existing evil is at once simple and effectual. If, for the next quarter century, we save all the wood used for mechanical purposes from the natural process of decay, and from destruction by insects, we shall have accomplished a result of the greatest conceivable importance to the whole country. If shelter is, indeed, the first necessity of man, it may be that, in more senses than one, this may be found at our very doors.

NEW AND IMPORTANT EXPERIMENTS.

THE National Wood Preserving Company's process has just been subjected to some new and interesting tests in New York which prove its value in other uses than any that have hitherto been considered. One of the most eminent scientific engineers in New York subjected two cubes of the same wood, one having been treated by the process and the other not, to a pressure of fifteen tons. On removing the pressure, the cube which had not been treated was found to be wholly crushed—the fibres being all more or less broken, and the integrity of the whole destroyed ; while the cube which had been treated by the preservative process, exhibited no other evidence of the pressure to which it had been subjected, than a scarcely perceptible compression amounting to just *one sixty-fourth of an inch.*

The importance of the fact here revealed, of the power of wood thus treated to resist compression and breakage, is too obvious to require a statement. Its importance in steamboat-building and railway cars is apparent. In a collision of steamers, for instance, everything depends, often-

times, upon the power of resistance possessed by the wood and timber work. The object sought, in developing the discovery covered by the Company's patent, was to produce by the anti-septic agents introduced into the pores of wood in the form of vapor from the oleaginous substances used, a condition of the wood which would enable it successfully to resist the process of decay. In other words, the only end sought, was to obtain a cheap and simple process to *preserve* the wood; so that, whether exposed for a century to the air and the elements, left under water, or buried in the ground, it would always be superior to any known *metallic* appliances for resisting decay. But it is found that its value is by no means limited to this result. The experiment above referred to, in its relations to ship and car building, and to many of the mechanic arts, is too important to be overlooked.—*Hartford Daily Times, July* 13, 1867.

HOW TO PROCURE IMPERISHABLE COFFINS.

THE question whether there is a more effectual agent to resist the approaches of decay than is now furnished in the metallic caskets used for burial purposes, is one which possesses direct interest for all of us. The objections to the metallic caskets are these: First, they are too expensive. Few people in moderate circumstances can afford, after incurring the already large necessary cost of a funeral, to add the further item of $75 to $100 for a metallic burial case. Again, these metallic cases are by far too heavy. And, lastly—and this is perhaps the most serious consideration—they fail to resist the destructive *corrosion* which acts with such well known energy upon all metallic substances buried in the earth. A metallic case will of course last much longer than one of common wood; yet how long can even the metal resist the corrosive action of the destructive agencies to which it is exposed?—Those who have had occasion to remove to some more desirable ground the buried remains of a beloved relative after the lapse of fifteen or twenty years, must have encountered painful evidence of the perishable nature even of the metallic caskets.

It is known that in coffins made of any wood which has been treated by the National Wood Preserving Company's process, an agent far more successful in resisting the approaches of decay has been secured; and at an expense, moreover, not more than that of an ordinary coat of paint. It is demonstrated that wood thus treated--permeated by the vaporized essences of the preservative agents employed—will remain sound and whole, when buried in the earth, for a period of at least half a century; and it is confidently believed, for even a much longer time. And no worm or insect will ever attack it. This has been abundantly proved, by experiment.—*Hartford Daily Times, July* 1, 1867.

THE INTERNATIONAL EXHIBITION AT PARIS.

The railroad sleepers on exhibition at Paris illustrate the vast importance of the products of coal tar as a means of preserving wood from decay. Imperfect as the European methods of treating wood obviously are, they have proved sufficient to preserve it unimpaired for a quarter of a century, But it is now conceded that the American patent, granted to Louis S. Robbins, covers the most simple and effectual process for the elimination of the antiseptic elements from the tar, and their application to the wood in the same process.

It is further to be observed, that the apparatus employed by the National Patent Wood Preserving Company of the United States can be constructed for *one-fifth* the cost of the machinery required under Mr. Bethell's English patent. Nor is this all: the American method is ten-fold more rapid and complete.

In the French section of the exhibition are shown railway sleepers which have been in use for several years. One of these sleepers, which was put down in March, 1859, and taken up in February, 1867, appeared as sound as when first cut. In the English collection is a sleeper from the Great Western Railway, which had been down for twenty-one years; one from the Lancashire and Yorkshire line which had been down for nineteen years; and one from the London and Northwestern Railway which had been in use for twenty years. These sleepers had been prepared by Mr. J. Bethell's process; they are all perfectly sound, showing that the preservative liquid had penetrated perfectly through each sleeper. Samples of timber are also shown which have been prepared with creosote, used in the construction of the chain pier at Edinburgh, and were perfectly sound, while timber which had not been so prepared was reduced to little more than half its original section by the effects of water and insects.—*Amer. Artisan*, May 22, 1867.

Creosoted Timber.—A creosoted sleeper, put down on the Stockton and Darlington Railway, in England, in August, 1841, was taken up March 14, 1867, after nearly 25 years' service. The grain of the wood, although slightly discolored by creosote, is as fresh, and apparently as tough as that of newly sawed timber, and the odor of creosote is as strong as if the wood had just been operated upon.—*Tribune*.

ROBBINS' LEVEE PATENT.

RIVER EMBANKMENTS. — MISSISSIPPI LEVEES, RECLAMATION OF SWAMPS AND OVERFLOWED LANDS, DYKING, DRAINING, ETC.

THE rich lands, in the lower Mississippi valley, bordering on the river, by a proper levee system will yield untold wealth to the individual proprietors, and also to the nation. There are also swamp and overflowed lands, in the American bottom opposite St. Louis, in the New Jersey swamps opposite New York, and in various portions of this great country, which by being properly dyked, and drained, can be thoroughly reclaimed, and be made immensely valuable.

Heretofore much has been done in the way of utilizing the sugar and cotton lands in the South, by the employment of embankments of earth, to prevent their overflow. The levees have been built, at great expense, of earth alone, which is composed of *sand and loam*, and hence very alluvial, and hence also very unreliable. The new, or green levee, not having settled, and acquired solidity by cohesion, is very often swept away by the first rise in the river.

The old levee, which in time has become firm, where it is highest, and has the greatest service to perform, is very often perforated, and honeycombed by the crawfish, and in some cases, by muskrats. And experience has shown, that wherever the water is allowed to pass the embankment either through the crawfish or muskrat holes, or by overflow, a crevasse is made and the whole country overflowed for miles. In this region stone might be employed to good purpose, but it cannot be had. Neither stone, gravel, nor coarse sand, is to be found on the *alluvial banks of the lower Mississippi.* But along the whole valley, there

is plenty of wood, an abundance of cypress, and other timber. But heretofore there has not been any application of wood to levee purposes, there has been no well digested plan for its use.

Lately, however, Mr. Louis S. Robbins, the inventor of New York, obtained a patent for the application of wood, in combination with earth, in the construction of levees.

He takes planks, (which are of course to be treated by his preservative process,) of the requisite length, two or three inches thick, and sharpened at one end. They are fitted to each other by a convex and concave edge. By means of a very ingenious guide, and a movable cap, he is able to drive these planks into the earth, in sections, all in line, and as well pointed, as if tongued and groved, when driven down to the required depth, the planks are fastened together at the top by a lateral brace which will hold them together, the earth is then thrown up against them from the inside, next the plantation. With this *water-tight* barrier in front, the water cannot displace the fresh and unsettled deposit of earth. Nor can the levee, thus constructed, be perforated by crawfish or muskrats, hence no crevasse from the inroads of these pests. In case of overflow, the water will fall over the wooden structure, as over a *milldam*, without wearing it away by washing, and *thus* causing a crevasse.

By the use of wood, in the same way, *swamp and overflowed lands can be reclaimed.*

Thus: Drive down the planks of timbers in sections, and jointed as stated above, pump out the water from the land to be drained. Then throw up the loam on the inside of the wooden dyke, and the overflow or seeping from ocean or river cannot again interfere with the cultivation of the territory thus protected.

The planks used in *Dyking*, or *Leveeing*, whether of cypress, cotton wood, or of any other kind of timber, must be treated by the *Preservative Process*, invented by said Robbins and now owned by the National Patent Wood Preserving Company.

By this process, which is the use of coal tar, wood tar, and other oleaginous substances and compounds in vapour the surface moisture will be driven from the planks, the albumen coagulated, they will be infused with creosote, which will prevent putrifaction, (Dry rot,) and then the fibre will be perfectly saturated with the vapour of oil, which will not only give it strength, but thoroughly protect it from the action of moisture. Planks made of any sort of timber can thus be made to last for centuries.

☞ Persons who have had years of experience in building levees in the South, give it as their opinion, that by the combination of timber and earth, as proposed by Mr. Robbins, more effective levees can be built at one half less expense, than the old earthern levees cost.

HOW TO OIL GUN-STOCKS.

By reference to the article on American Forests, page nineteen, it will be perceived that during the first and second years of the late rebellion, a single European manufacturer of guns used no less than 28,000 black-walnut trees to supply gun-stocks for the American market. This fact but imperfectly suggests the immense consumption of wood for this purpose, and the vast number of gun-stocks annually required to supply the demands of all nations.

At present gun-stocks are all oiled by the slow method of hand labor. This requires much time and involves a

heavy expense; but this labor may be nearly all saved by adopting the Robbins process, which, at the same time, hardens and beautifies the wood and renders it less liable to crack and break. Three thousand gun-stocks or more may at once be placed in a chamber, and one common laborer, employed to tend the apparatus, will thus *oil the whole of them in three hours*, and in the most effectual manner.

PORTABLE APPARATUS.

The machinery employed by Mr. Robbins is inexpensive, as compared with that used by Mr. Bethell of England, and also in the comparison with the apparatus employed in treating wood with mineral solutions. The construction of the apparatus recommended by Mr. Robbins is also simple and portable; while the machinery used by others is large, complicated and expensive, that constructed by Mr. R. may be easily mounted on trucks, and run over the entire length of a railroad; and, consequently, the heavy labor, and expense of transporting ties and other lumber from place to place, may be avoided.

FROM THE SCIENTIFIC AMERICAN.

THE ART OF PRESERVING WOOD.

Wood is an article of prime necessity and stands foremost in its connection with every conceivable interest within the range of civilization. Millions of men and unlimited capital are daily employed in converting wood and lumber to the innumerable and necessary uses required for human comfort. So great is the demand for lumber in the progress of the arts and civilization, that our native forests, which so recently covered nearly the whole of the Eastern and Middle States, have been brought into requisition and removed, except small portions at great distances from market or situated in almost inaccessible localities. The increase of our population and the improvements in the arts, generally, have been so rapid, that even now it is a serious problem as to where we are to obtain our future supply of wood and lumber.

Notwithstanding wood is so intimately and extensively connected with all the various interests of human progress, and the vast and unlimited means devoted to its conversion from its condition in the forest to its ultimate uses, it cannot have escaped, even the most casual observer, that it is, nevertheless, an article subject to rapid and useless decay. It is a no less important fact that wood occupies a place that cannot be supplied by all the other resources of nature aided by human invention.

It now becomes a matter for serious inquiry whether we cannot accelerate the growth of wood or preserve it from decay. Indeed, this has long been a subject of most earnest inquiry and deep concern in countries of an older civilization than our own; and within the last thirty years the inventive genius of man has been taxed to devise means by which so desirable a result could be obtained as the preservation of wood. In view of the immense expenditure of time and capital, devoted to fashioning and adapting wood to the various forms and uses required, it is obvious that no greater achievement can be made in the useful arts than the effectual preservation of wood from decay, and the saving of the vast annual expenditure required in removing the things which the elements have destroyed, and in supplying new materials and structures in their place.

Out of the great number of inventions and patents made and obtained for this purpose, one invention—that for which Bethell obtained Letters Patent in England in 1838—has demonstrated the fact, that by the use of oleaginous compounds, obtained from the distillation of coal tar, properly applied, wood can be preserved for an indefinite length of time.

The following named inventions and patents, made and granted in Europe, are referred to for the purpose of showing some of the means which have been resorted to—without substantial success—to obtain this desirable result; and also to afford such information to the public as will guard it against any ex-

penditure of means with a view to the introduction of such processes in this country.

Kyan's process for preserving wood was the first to attract general attention. It was introduced in 1832, and subsequently patented in this country. The process consists in saturating the wood with a dilute solution of corrosive sublimate. This method, always too expensive to admit of general application, has been wholly abandoned in this country.

In 1837, one Margary obtained a patent in England for preserving timber by immersing it in a solution of acetate or sulphate of copper. After being thoroughly tested in England this process has gradually yielded to other processes.

In 1838, Sir William Burnett's process was patented, and since that time Burnettizing wood has been practiced in Europe and America. In this process the wood is saturated with a concentrated solution of the chloride of zinc. While Kyan's discovery failed of being widely adopted, from the fact that the material employed was too expensive to admit of being generally used, Burnett's process, for a similar reason, has only been employed to a limited extent.

Payne's process was patented in England in 1841. He employed two solutions, successively, which naturally decomposed each other, forming an insoluble substance in the pores of the wood. The earthy or metallic solution is first introduced into the timber, under pressure; after which the solution is drawn off and the decomposing fluid forced in. Sulphate of iron and carbonate of soda are said to form the insoluble compound in the pores of the wood. This process has been tried in England and this country, and has met with some favor in France.

Dr. Boucherie, a distinguished French chemist, invented a process for preserving wood, and for which he procured a patent. It is claimed that this process accomplishes two objects:—First, it expels the sap; and secondly, it fills the pores of the timber with a preservative solution. The fluid that is alleged to preserve the wood is so introduced by pressure that it "passes longitudinally along the fibers," thus expelling the sap and occupying its place. The claims of this process are being urged in this country under the false pretence that it is a new discovery.

Bethell—by his process patented in England in 1838—rendered wood more imperishable by the use of a cheaper material; but his machinery was unnecessarily complicated, and his method of conducting the process quite imperfect and too expensive to admit of general application. We extract the following partial description of Bethell's process from a small treatise on the art of preserving wood, published in this country in 1859:—

"It consists in impregnating the timber with an oily matter obtained from a rough distillation from coal tar. This oily matter contains a variety of substances, having different chemical properties; one of the essential ingredients for this purpose is said to be creosote, which forms, as estimated, about thirty per cent. of the product of distillation used for this purpose. The other in-

gredients have a no less important effect. The oily matter is injected into the timber by pressure in closed vessels, from which the air is first partially exhausted."

The subjoined letter from Dr. Dwinelle, who personally witnessed what he describes, is sufficiently explicit, in respect to Bethell's machinery and process.

"LOUIS S. ROBBINS,—*Dear Sir:* I cheerfully comply with your request to give you such information as I obtained in Europe, several years ago, in regard to the use of *coal tar* and its products as a means of preserving wood.

"In 1852, while investigating different matters of public interest in London, I was invited by Mr. Burt to visit his extensive works on the Surrey side of the Thames, where he had, for several years, been treating—for the English and India markets—large quantities of wood with products of coal tar, according to a process patented by Mr. Bethell in 1838.

"His process consisted in placing the wood or lumber in a large iron cylinder, constructed expressly for the purpose, and made very strong. When these cylinders were sufficiently charged with wood—it being carried into them on cars constructed for the purpose—the ends were closed in such a manner as to render them perfectly tight, the air and moisture were then exhausted, as nearly as possible, by air pumps attached to the apparatus for that purpose, Then other pumps were employed to force the liquid product, that had been obtained by distillation of coal tar, into the cylinders, which was continued until a pressure of 150 lbs. to the inch was reached. After a certain time had elapsed, the wood was taken out of the cylinders and placed in a suitable position for drying, when it was ready for use.

"The machinery employed for these operations was both complicated and expensive, and so imperfect, in respect to its capacity to produce the result desired, that a large amount of time was required to saturate the wood to any considerable extent, or in a degree sufficient for the purpose of its preservation. This method, however, was considered the best then known, and had been proved to be a success for many years, by the practical use of the wood thus treated.

"Bethell's process seemed to be very objectionable, not only because it required much time and labor, but also for the reason that it was only suited to the treatment of lumber to be used for the most ordinary purposes, such as railroad sleepers, piles for wharves, bridges, etc., etc.

"I have carefully examined your patented process. It appears to be simple, rapid and inexpensive, and much more perfect in its results than Bethell's, inasmuch as the hot oleaginous vapors arising from the distillation of the coal tar must, under the circumstances, permeate every portion of the wood or lumber to any extent required.

"Your process is open to none of the objections urged against Bethell's plan, since, by its use, wood may be rapidly and properly treated for all the various uses to which wood is applied in the mechanic arts. Moreover, the

fact that you use the same material leaves no doubt as to the success of your patent, it having long since been practically established in Europe, that the products obtained from the distillation of coal tar, if properly applied to wood, will preserve it for a great length of time from decay, and also from destruction by marine and other insects. Truly yours,

"WM. H. DWINELLE, M. D., No. 119 Tenth Street, New York."

The great value of Bethell's discovery has been so clearly demonstrated, by the uniform results of its application, that scientific men in Europe, and especially the most distinguished engineers in England, have come to entertain but one opinion of its merits. It can hardly be necessary to multiply authorities in this connection, since the following emphatic testimony—extracted from Dr. Andrew Ure's "Dictionary of the Arts," must satisfy the most skeptical reader. Treating of the results of Bethell's process he says:—

"The effect produced is that of perfectly coagulating the albumen in the sap, thus preventing its putrefaction. For the wood that will be much exposed to the weather, and alternately wet and dry, the mere coagulation of the sap is not sufficient; for although the albumen contained in the sap of the wood is the most liable and the first to putrify, yet the ligneous fibre itself, after it has been deprived of all sap, will, when exposed in a warm, damp situation, rot and crumble into dust. To preserve wood, therefore, that will be much exposed to the weather it is not only necessary that the sap should be coagulated, but that the fibres should be protected from moisture, which is effectually done by this process.

"The atmospheric action on wood thus prepared renders it tougher, and infinitely stronger. A post made of beech, or even of Scotch fir, is rendered more durable, and as strong as one made of the best oak, the bituminous mixture with which all its pores are filled acting as a cement to bind the fibres together in a close tough mass; and the more porous the wood is, the more durable and tough it becomes, as it imbibes a greater quantity of the bituminous oil, which is proved by its increased weight. The materials which are injected preserve iron and other metals from corrosion; and an iron bolt driven into wood so saturated, remains perfectly sound and free from rust. It also resists the attack of insects; and it has been proved by Mr. Pritchard, at Shoreham Harbor, that the *teredo navalis*, or naval worm, will not touch it.

"Wood thus prepared for sleepers, piles, posts, fencing, etc., is not at all affected by alternate exposure to wet and dry; it requires no painting, and after it has been exposed to the air for some days, it loses every unpleasant smell.

"This process has been adopted by the following eminent engineers, viz.: Mr. Robert Stephenson, Mr. Brunell, Mr. Bidder, Mr. Brathwaite, Mr. Buck, Mr. Harris, Mr. Wickstead, Mr. Pritchard, and others; and has been used with the greatest success on the Great Western Railway, the Bristol and Exeter Railway, the Manchester and Birmingham Railway, the North Eastern,

the South Eastern, the Stockton and Darlington, and at Shoreham Harbor; and lately, in consequence of the excellent appearance of the prepared sleepers, after three years' exposure to the weather, an order has been issued by Mr. Robert Stephenson that the sleepers hereafter to be used on the London and Birmingham Railway are to be prepared with it before being put down.

. . . . . .

"For railway sleepers it is highly useful, as the commonest Scotch fir sleeper, when thus prepared, will last for centuries. Those which have been in use three years and upward, look much better now than when first laid down, having become harder, more consolidated, and perfectly water-proof; which qualities, combined with that of perfectly resisting the worm, render this process eminently useful for piles, and all other woodwork placed under water."

It is stated by the best authorities, and confirmed by ordinary experience and observation, that the decay of wood is due to the action of oxygen and moisture; and we find that in proportion as it is excluded from these destructive agents it retains its durable and substantial qualities. It would seem that the direct effect of these elements is to remove the antiseptic principles of the wood, and afterward to permeate its substance with moisture, thus softening its fibrous portions and producing mold or decay.

From this brief statement it will be obvious that to preserve wood it must, in some way, be protected from the action and influence of these decomposing agents. In its growing state, wood has all the elements of self-preservation; and, if undisturbed, it will continue to live and grow without decay during the natural period of its development. When a limb is broken, the bark removed, or an abrasion made, so as to expose the circulating fluids to the action of the elements, then decay commences—this fact is patent to all observers.

All growing wood has an oleaginous covering, which protects the fluids from the elements, but when wood is cut down and the oily supply for the surface can no longer be obtained from the soil, artificial means must then be employed that will fully protect the wood from the influence of oxygen and moisture. Oleaginous compounds, such as are obtained from the distillation of coal tar and similar substances, are adapted to this purpose; and they can be applied to wood in such a manner as to preserve it for an indefinite period. This is what is accomplished by Mr. Robbins' patented process hereinafter described. The oily products obtained from the distillation of bituminous substances are not decomposed and destroyed by the action of oxygen and moisture at ordinary temperatures. Hence, when they are properly applied to wood they must protect and preserve it.

It appears to have been the leading idea with all the European inventors, if we except Bethell, to deprive wood of some of its important constituents and essential properties, or to otherwise change them by chemical action. In this, they not only disregarded the common experience of all ages, but they were at war with Nature. The common mistake among them consisted in attempting to produce a condition of wood that is wholly unlike its living state,

instead of restoring to it what had been lost by time and exposure to the elements. Moreover, while the materials used actually destroyed the native integrity of the wood, they were of far too costly a nature to admit of general application. For these reasons the several processes of Kyan, Margary, Burnett, Payne and Boucherie, will ultimately be regarded as failures, practically and in every essential sense.

Very different will be the public verdict respecting the claims of Bethell's discovery. How far he really comprehended, or even perceived the principles which the subject involves, we may not be able to determine; nor is this important in estimating the value of what he accomplished. It is manifest that his course of experiment was in the right direction. He sought to preserve, by artificial means, the vitality of Nature—to prevent the loss of those constituents and properties which are essential to wood in its normal and undecaying state. To him belongs the credit of originality, and of furnishing the potent suggestion which has enabled Mr. Robbins to complete a discovery second to no achievement in the useful arts, in the universality of its application, and in the consequent magnitude of its practical results.

Hitherto we have discovered nothing that will so effectually resist moisture as oil. It is not only a demonstrated fact in science, but it has become a proverb everywhere, that oil and water have no affinity—that they will not unite. While water finds its way through the closest animal tissues and into the hardest wood, and, by mechanical pressure, may even be forced through the solid metals, this antagonism between oil and water is universal and irresistible. This suggests the immense value of oil in the preparation of all durable fabrics and manufactures of wood that are required to be impervious to moisture. In all civilized countries, and back through the entire historic period of the world, men have acted on this suggestion; in the preparation of the skins of animals for shoes and for other purposes; in the manufacture of various outside garments; in painting their dwellings, ships, fences, furniture, and all the other superstructures of wood. These are rendered durable by the proper application of oil, and in proportion as the oil so applied is of a nature suited to endure the action and influence of oxygen and moisture.

The vegetable and animal oils differ essentially in their constituents from the oleaginous compounds derived from bituminous substances. The difference in their inherent capacity to resist moisture is equally marked and no less deserving of notice. The exposure of the former to the action of the elements gradually diminishes this power of resistance. Heat brings the organic oils to the surface of whatever they are applied to, and some of them are soon dissipated so that they no longer afford a sure protection. But it is not so with the products of coal tar, or with the bituminous oils. These, instead of being dissipated in part, or otherwise impaired by the ordinary changes of temperature and the varying degrees of moisture, become resinous from exposure, and hence the substances to which they are applied become harder and more durable by time. It is the unqualified testimony of Dr. Ure that railroad sleepers,

that had been in use for more than three years, "looked much better than when first laid down."

At the time we write corrosive sublimate is worth one hundred and thirty-five dollars per one hundred pounds, while chloride of zinc is still more expensive. The preparation of railroad ties, by the use of such materials—if we allow one pound to a single tie—would cost not less than one dollar and a half each, while the cost of a far more effectual treatment, by the products of coal tar, would scarcely exceed ten cents. In the treatment of railroad ties and the timber for bridges and wharves, acids and alkalies are especially objectionable because they corrode the iron bolts and spikes, and thus impair and ultimately destroy the wood with which they are in contact. If copper nails and sheets be employed, as in covering the hulls of vessels, the corrosion must be more rapid when such substances have been employed in the preparation of wood. On the contrary, oil prevents this corrosion of the metals, and in this respect it contributes essentially to the inherent durability of any structure that may be made of such composite materials.

SPECIFICATIONS OF THE ROBBINS PATENT.

To All Whom it may Concern :—Be it known, that I, Louis S. Robbins, of the City, County and State of New York, have invented a new and improved process for preserving wood from mold or decay; and I do hereby declare that the following is a full, clear and exact description thereof, which will enable those skilled in the art to make and use the same, special reference being had to the accompanying drawings, forming part of this specification.

It is a well-known fact, that wood, when cut down, and separated from the roots which supply it with its antiseptics, immediately becomes affected by exposure to the heat and the moisture of the atmosphere; the former of which rapidly dissipates the fluid or sap of the wood, while the latter impregnates the woody fibres with substances which the wood, while growing, by its antiseptics, entirely excluded. These alternate actions upon the wood gradually and finally cause it to decay. To prevent this decay of wood is, therefore, the object of the present invention, and this object is accomplished thereby. The method consists in subjecting the wood to a preservative process by which nearly all of its antiseptics are retained within the same; and for those lost, supplying such substances as will prevent their further waste; at the same time closing the pores and forming such a combination with the fibres of the wood as will effectually prevent the deteriorating effects of either heat or moisture at ordinary temperatures, or of both upon the same, as hereinbefore alluded to.

Many processes have been heretofore invented for the preservation of wood, some of which were entirely impracticable, while others were only partially successful; but by none could the wood be sufficiently impregnated or satu-

rated with the preservative compound, to insure its preservation for a great length of time, owing to the manner in which the same was applied to the wood.

One form of apparatus for carrying out my improved process is represented in the accompanying plate. A, in the drawing, represents a retort, made of any desired form or size, in which coal tar, resin, or oleaginous substances or compounds are placed, and subjected to the action of heat from any suitable furnace. B represents the man-hole in the upper portion of the retort, used in cleansing the same or in changing its contents. C C, a pipe communicating with retort A, at or near its top, passing to, and communicating with, chambers or receptacles, D. E represents the discharge pipe, employed for removing the remaining contents after the operation is over.

Heat being applied to retort A, containing the coal tar, etc., as described, oleaginous vapors are generated therein, which pass out of the same through the connecting pipe, C C, into the wood chambers, D, or into only one of the same as may be desired. The heat thus applied first causes the surface moisture of the wood to be removed therefrom, taking the form of steam and condensing on the sides of said chamber, from which it is drawn off through pipes, H, which may be placed in or near the bottom.

Having thus removed the surface moisture from the wood, I then thoroughly impregnate and saturate it through all its pores and fibres by the oleaginous vapors and heavier products of the distillation, until it is made impervious to moisture, and so as to entirely resist the action of the atmosphere, when it may be removed from the chambers, D, through the doors, M M; when the chambers are again to be charged with wood, and so on as long as may be desired.

In the operation of my process, a temperature of from 212 deg. to 250 deg. Fahrenheit is sufficient to remove the surface moisture from the wood; but to saturate the same with oleaginous vapors and other products, it is best that the temperature should be raised to 300 degrees Fahrenheit, or higher if necessary.

From the above description, it is apparent that, by my process, I am enabled to more completely saturate the wood with the preservative compound than has been, or can be done by any of the processes heretofore in use; for the reason that I cause the preservative compound to permeate the pores and fibres of the wood, in a vaporized state, while in the others it is made to enter in a liquid state; and it is also evident that it is accomplished in an economical, expeditious, effective and practical manner.

I do not intend to limit myself to any particular form of apparatus; nor do I intend to limit myself to the removing of the surface moisture from the wood by means of oleaginous vapors, as herein described, as there are various ways in which the same can be accomplished with the use of heat. But what I do claim as new, and desire to secure by Letters Patent, is:

The process herein described for preserving wood from mold or decay, the same consisting in first removing the surface moisture from the wood, and then

charging and saturating the same with hot oleaginous vapors and compounds, substantially as described.

Also removing the surface moisture from the wood by means of hot oleaginous vapors, substantially as herein described.

LOUIS S. ROBBINS.

Witnesses:
M. M. LIVINGSTON,
ALBERT W. BROWN.

It will be perceived, from an examination of the foregoing specification, that Mr. Robbins' method of treating wood possesses great advantages over even that of Bethell. Indeed, it will be obvious, on a moment's reflection, that his process must be far more rapid and complete. For while Bethell employed his oleaginous compounds in a liquid state, Robbins uses the same materials in the form of vapor, in which condition they are sublimated to a degree which is eleven hundred times finer than they are in the state in which Bethell employed them, and, of consequence, so much the more penetrating. In this state of extreme attenuation, the elements which preserve the wood are more readily admitted—the capillary action being greatly accelerated and made to thoroughly permeate the entire structure of the wood. At the same time the hot vapor opens the pores and expands the wood, so that a larger quantity of the oily compound is admitted. The pores being thus filled, the contraction which naturally results from the cooling process, seals them, if possible, in a still more effectual and lasting manner. The vast superiority of the Robbins process, as compared with that of Bethell, can only be fairly estimated by those who realize the immense difference between the effectiveness of water and steam in their relations to chemical action and mechanical force.

But we should fail in our attempt to comprehend the full value of this improvement were we to overlook other important considerations. It is to be observed that this process renders light and porous wood as solid and durable as the finest grained timber, and perhaps equally well adapted to all ordinary purposes in the arts. In fact, it may admit of a question whether the most porous wood may not be made to last even longer than the wood that is least so, from the fact that it absorbs a greater quantity of the material on which its preservation is made to depend.

Wood, treated by the Robbins process, requires no paint as a means of protecting it from the ordinary action of the elements. Paint is, therefore, useless except for ornamental purposes; and even then, so much of it as is required to fill the pores is saved when the wood has been previously treated by this method, and this saving will doubtless cover the cost of the most effectual treatment under the patent.

It is, moreover, important to observe that this process seasons the wood most effectually; and inasmuch as it thoroughly protects it from the influence of moisture, it follows that wood so prepared is neither liable to swell, shrink, warp nor crack.

A just estimate of this last and most perfect process for preserving wood might suffice to startle every thoughtful man in the community. Experience proves that to ensure the traveling public against accidents, resulting from decayed railroad sleepers, the whole should be removed at least once in five years. The present cost in the Middle States is seventy-five cents each; and it will be safe to assume the average price to be fifty cents throughout the entire country. Add fifty cents each to this, as the probable cost of removing the old sleepers, putting down the new, and replacing the rails, and it will be perceived that every new sleeper that is supplied involves an expense, in material and labor, of one dollar. As railroad ties are placed at an average distance of about two feet, it follows that 2,500 are required in a single mile. Hence, it costs about twenty-five hundred dollars ($2,500) per mile to remove the old sleepers and lay down the new ones. As there are fifty-thousand miles of rail tracks in the United States, it will appear that $125,000,000 are demanded to support the rails of all the roads in the country.

These figures indicate the enormous expense of a single renewal of the sleepers of all our railroads. If thus renewed once in five years, the inevitable cost, in the next twenty-five years, of the new ties for the roads already constructed will amount to 625,000,000 of dollars! Now, it being demonstrated that sleepers, prepared by the process already described, will last a quarter of a century, the conclusion is inevitable, that the universal application of the Robbins process, to the ties of all our roads, would involve a saving—after deducting the cost of their preparation under the patent—of some 450,000,000 of dollars. Moreover, if the progress of the construction of such roads, for the next twenty-five years, should continue to be, at the rate it was during the six years next preceding the late rebellion (2,000 miles per annum), the saving of money in railroad ties, and in the labor of laying them down, would not fall much short of 700,000,000 of dollars!

But the complete contrast between the Bethell and the Robbins processes requires the presentation of another important feature. The wood prepared by Bethell was only fit for timber that was fashioned and adapted to the rudest forms and uses, such as railroad ties, the piles for bridges, wharves, &c., for the reason that the surface was left covered with the grosser products of coal tar. But as the Robbins process applies the same in the form of vapor, the wood is left clean; and after a few hours' exposure to the air, it is fit to be handled and used for any purpose in which elegant workmanship is required.

Apart from mere pecuniary considerations, the preparation of railroad timber by this process is immensely important as a means of safety. A large number of railroad accidents occur in this country from the rapid decay of the sleepers. This is, of course, unequal, some of the ties rotting and giving way, while others remain in a sound state. This causes an oscillating and irregular motion of the cars, which sometimes throws the train off the track; it also occasions an unequal pressure on the rails, which are liable to break. The violent motion, resulting from the uneven surface of the track, causes unequal friction.

and an undue strain on the axles, and on the flanges of the wheels, the breaking of which constitutes another prolific source of railroad disasters.*

The direct loss to our railroad corporations, in the destruction of property by such accidents, is very heavy; but it would be quite impossible to compute the still greater loss that is indirectly sustained. The fact cannot be disguised that the seeming indifference of railroad companies to the public safety has the effect to greatly diminish the travel. Multitudes who would make frequent excursions for pleasure but for a feeling of insecurity, now only venture from home when the pursuits of business or other circumstances imperatively demand it. Beside, if the distance be short, many persons use a conveyance of their own, when they might travel by rail at less expense of both time and money. It is a false economy that refuses to accept and apply a great improvement when once it is demonstrated to exist; and our railroad directors, must be made to feel that it is even criminal to disregard such a discovery when it is known that the public safety demands its immediate adoption.

We have only estimated the value of Mr. Robbins' process for preserving wood in its relation to a single use. And yet, wood is the chief material employed in the world's navies and merchant marine; in the construction of our dwellings, workshops, warehouses, carriages, fences, agricultural implements, and household furniture. The millions require it in fashioning the implements of toil; three-fourths of the products of the earth, and of all human industry, are inclosed in wood for preservation or transportation; the masses, in all countries, warm their dwellings and cook their food by its combustion, and the whole vast commerce of the world still rides on every ocean and sea in vehicles of wood.

The new process is equally applicable to wood in all its uses except for fuel. But we have no data from which a reliable estimate can be made of the immense saving which would result from its universal adoption.

THE SCIENTIFIC ASSOCIATION ON WOOD PRESERVING.

S. B. BRITTAN, M. D., member of the New York Association for the Advancement of Science and Art, some time since read a carefully prepared paper, on the History and Philosophy of Preserving Wood, before the Engineering Section of that body. The following is an extract from Dr. Brittan's paper, which appeared, *in extenso*, in one of the daily journals :

There are several processes, natural and artificial, whereby wood—at least the insoluble portion of the same—may be preserved for an indefinite period. When the oily and resinous matter, and all the volatile products of wood are

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* The great destruction of life by railroads in this country is rapidly becoming a cause of national reproach. It is well known that railroad accidents are far less numerous in Europe than in this country. Nor is the comparative infrequency of such disasters in England, France and Germany, altogether attributable to the superior construction of their railroads. It is due in no small degree to the fact that their railroad ties are subjected to some process which renders them less liable to decay.

removed by a slow combustion, the carbon remains in the form of charcoal. This is a very poor conductor of heat, and a powerful antiseptic; exposure to air and moisture does not materially change its condition; and hence it will not decay. Carbon in this form is well nigh imperishable, except by combustion; while in the pure, crystalline state, it can only be destroyed by the application of heat sufficiently intense to consume the diamond. Piles, posts and stakes are often charred on the surface to preserve them from decay. Men who follow the sea likewise char the outside of casks and tanks by which means the water contained in them is kept cool and pure during long voyages into tropical regions. Whenever—by other means than combustion—the soluble matter is expelled, only the lignine, or fibrous portion of the wood remains, and this is quite imperishable, except when it is attacked by parasitic fungi. In this case the effect becomes visible in the *dry rot*, which gradually destroys the organic structure and the cohesion of is elements.

We have other conditions of certain constituents of wood, in which they are indestructible by the ordinary action of oxygen and moisture. These conditions are found in the carboniferous formations and bituminous deposits in the earth, which are doubtless the products of extinct vegetation, formed by immense pressure and the action of volcanic fires—resulting in vast condensation; and, in respect to the coal beds, the dissipation by heat, and expulsion by pressure or otherwise, of the fluids and gases from the subterranean forests.

Resinous substances preserve wood and other organic forms of matter. A pitch pine knot will last for a century—buried in the ground—preserved by the common resin it contains. The fossil resins may also be used to preserve both vegetable and animal substances. The ancients were as familiar with these facts as the moderns. It is said that the temple of Diana at Ephesus was built on piles, which were found—within the last century—to be in a state of perfect preservation, the surfaces of the same having been charred and otherwise treated to render them imperishable. The early Greek historians speak of the uses to which asphaltum was applied; and we learn from Pliny and others that the Egyptians employed this substance and the pyroligneous acid of wood in the process of embalming their dead.

The scientific philosophy of the Robbins process for preserving wood may be briefly suggested in this connection. Albumen is the constituent in wood which first decomposes; and herein the process of decay or putrefaction commences, and proceeds until the woody tissue is destroyed. But the albumen in the sap is coagulated by the application of heat, and also by the antiseptic power of creosote which the oleaginous vapors deposit in the cellular tissue. Coagulated albumen is insoluble in water, and hence it is not liable to be changed by exposure to a humid atmosphere. The essential oil, disengaged and vaporized by distillation, preserves the elasticity of the ligneous fibre of the wood, and protects it against injury from the ordinary vicissitudes of temperature and moisture. When wood has been treated by coal tar, or the bituminous oils, it undergoes a certain other change from subsequent exposure to

the air. The essential oil loses a portion of its hydrogen, at the same time it takes up an extra portion of oxygen from the atmosphere, and hence becomes *resinous.*

That the antiseptic principle derived from coal tar—in the Robbins process—is readily introduced into and through both animal and vegetable substances, must be obvious. The process of curing meat furnishes a familiar illustration. One has only to taste of a smoked ham to find that the creosote has found its way to the center. The metallic salts likewise have the effect to separate the albumen from its aqueous solution, thus preserving it from putrefaction. The albumen and gelatine of animals when combined with tannin also form insoluble compounds, and thus the skins of animals are made to resist the agents which would otherwise produce a putrescent state. Morever, by the intimate combinations thus formed we account for the antiseptic properties and effects of corrosive sublimate and chloride of zinc as applied to the preservation of wood, in the processes employed by Kyan and Sir William Burnett.

In the Robbins process the surface moisture is soon dissipated by heat, and the wood is thus partially seasoned. The more volatile oil first passes off, entering the open pores—not less than two or three thousand in number to each and every inch of surface. It is well known that the capillary action is greatly increased by heat; and the oleaginous compound—in a state of the greatest possible attenuation—is rapidly diffused through all the substance of the wood. By increasing the heat, the heavier products arising from the distillation are made to thoroughly permeate the woody tissue, and at last to close up the capillary tubes, leaving the entire surface of the wood impervious to moisture.

The great importance of this treatment is so fairly established by the results of Bethell's experiments, and the experience of more than a quarter of a century, that Dr. Andrew Ure affirms that, "the commonest Scotch fir sleeper, when thus prepared, will last for centuries."

A GREAT EVIL AND THE REMEDY.

We extract the following from a leading editorial that appeared in the Hartford (Conn.) Daily *Times*, of the date of September 29th, 1865:

The increasing frequency of railroad disasters, accompanied by a frightful destruction of human life, is exciting general apprehension, and calling attention to the best means of guaranteeing the traveling public against the recurrence of such accidents. We are persuaded that a thorough investigation into the causes of railroad disasters would clearly demonstrate the fact that a large number result from the decay of railroad ties and the destruction of the piles of bridges by marine worms. Experience has proved that the ties or sleepers of railroads only last about five years. The precise time, of course, varies according to the varying degrees of inherent durability and the vicissitudes

resulting from unequal exposure to the elements. The decayed timbers are only removed when, by a superficial inspection, they are discovered. The surface may, however, present a fair appearance when the substance is chiefly wasted by the process of decay. At length the rotten sleeper yields to the heavy pressure; a rail breaks, and away goes the train, freighted with living beings, to sudden and almost certain destruction. It is certain that a long chapter of terrible accidents may be justly ascribed to this cause, and that the breaking of a rail is far more likely to occur in consequence of the giving way of the sleeper that supported it than from any flaw or other defect in the iron.

It may be said that the proper functions of the public press, in its relation to a subject of this nature, are but half performed when the attention of the community is arrested by the fearless exposure of a great evil. Its next duty is to discover the means and instrumentalities of reform, and by forcible appeals to the enlightened judgment and moral sense of the community, to *compel their adoption.* And here we may render a public service by calling attention to the new process for preserving wood from decay, for which Mr. Louis S. Robbins, of New York, has recently obtained a patent. The fact that wood may be preserved for an indefinite period, either by the infiltration of a dilute preparation of corrosive sublimate, a concentrated solution of the chloride of zinc, or by covering its surface and permeating its substance with an oleaginous compound, was long since demonstrated in England. But the several processes adopted in Europe were not susceptible of very general application, owing to the imperfect machinery and methods employed, and the heavy expense necessarily incurred in procuring the requisite materials. All of these difficulties are, however, obviated by Mr. Robbins, who virtually restores and preserves the condition of the live wood by a very easy, cheap and rapid process. Railroad sleepers that would otherwise decay in five years, are made to last a quarter of a century; and the whole preserving process, extending to the very center and heart of the wood, is scarcely more expensive than a single coat of paint on the surface.

As the Robbins process prevents wood from either shrinking, warping or cracking, and, at the same time, renders it indestructible by marine worms, it follows that his method is equally applicable to all the uses (its use for fuel alone excepted) to which wood is applied. The vast commercial consequence of such a discovery can scarcely be exaggerated.

In addition to the immense saving of timber—already a matter of increasing interest and vital importance to the country—the formal use of this process would inevitably save a very large proportion of the mechanical labor and productive industry of the world, by the quality of superior durability thus given to all the artificial structures made wholly or in part of wood. The saving of railroad timber, in this country, would alone amount to some 20,000,000 of dollars annually; and to this sum we must make a further annual addition of not less than forty thousand dollars for every hundred miles of railway that may be constructed hereafter.

The preparation of ship timber by the new process can scarcely be less important than the application of the discovery to railroads. Previous to the late rebellion some of our ships of war were rotting on the stocks before they were finished, involving a loss of both materials and labor. Moreover, not only the tropical seas, but the waters of the temperate zones swarm with marine worms that sometimes destroy the hulls of vessels in a few weeks or months. These worms are liable to attack and riddle the piles of bridges, boring silently beneath the surface of the water, and thus invisibly but surely destroying the integrity of the whole structure. It is a fact that extensive and seemingly durable works are frequently weakened and sometimes wholly destroyed in this way. New Holland was once inundated by these apparently insignificant creatures. Whole villages were made desolate, and 40,000 acres of cultivated lands left a barren waste, the *Teredo Navalis* (Linnæus) having destroyed the piles of the dyke Leeüwarden. As the Robbins process for preserving wood is said to be a complete protection against the ravages of these omniverous worms, it merits the early attention of shipwrights, the builders of bridges and wharves, and especially of the Navy Department.

At least we may hope that a careful examination of our railroads will soon be instituted, and that the public will imperatively demand the immediate adoption of every new improvement that may afford greater security to the traveling public. If there are railroad and transportation companies that will not promptly employ every means that may tend to the preservation of life, let the selfish and soulless policy of such corporations be freely and fearlessly exposed. Let the people understand that *such roads are traps and snares that lead to death;* and that the manifest crime of their managers is at best constructive homicide. As far as possible let all such lines of travel be abandoned, let the interests of their owners perish, to the end that even licensed criminals may be punished, and human life be respected and preserved.

FROM THE AMERICAN ARTISAN.

PRESERVATION OF RAILWAY TIMBER.

A due regard for the safety of the traveling public requires a careful investigation into the condition of all the railways and railway-bridges in the country. Since the commencement of the late rebellion many of them have not been properly repaired. It requires 125,000,000 of ties for the 50,000 miles of railtracks in the United States. Owing to their constant exposure to the elements, the rapid process of decay renders it necessary to lay down new ones as often as once in five years, at an expense of more than 60,000,000 of dollars. But circumstances growing out of the late war, and the diminished supply and increased cost of the timber, have occasioned a general neglect, the consequences of which are daily more apparent. The directors and stockholders of railways jeopardize human limbs and heads to save the small cost of chestnut logs.

The old sleepers are permitted to remain, to save expense, until one by one they yield to the weight of trains, when a rail breaks, and another chapter is added to the record of human sacrifices.

There is reason to apprehend that the piles of some railway-bridges are perforated in all directions, beneath the surface of the water, by marine worms; and yet no proper investigation is either instituted or demanded. Owing to this neglect, and the decay of railway timber, we may expect that the number of accidents of this class will increase, until the evil finds a violent remedy in exasperated public sentiment.

In the Northern and Middle States the supply of timber is diminishing. Railway ties that once cost thirty cents are now worth double that price, in the same localities; and the facts are such as to occasion apprehension among those who are most concerned in railway enterprises. For obvious reasons, it should be a matter of deeper interest to the public. It is difficult to substitute any other material for many of the uses to which wood is applied. If this cannot be done, and the quantity is likely to be insufficient in the future, then some means should be adopted to prevent the present waste of an article so necessary to the progress of the useful arts. If we cannot accelerate the growth of timber, it is well to consider what may be done to arrest its decay.

As early as 1838 Bethell's process for preserving wood was patented in England. Kyan's method, and the process discovered by Sir William Burnett, attracted attention about the same time. They employed corrosive sublimate and chloride of zinc, respectively, while Bethell covered the surface and filled the pores with an oleaginous compound. The results of these experiments demonstrated the feasibility of preserving wood for an indefinite time; but the methods employed were imperfect; and, if we except Bethell's process, the materials were too expensive for general application. It remained for an American to perfect this important discovery.

Mr. Louis S. Robbins, of this city, has recently patented a new process, in which he employs the antiseptic principle derived from a distillation of coal tar. His machinery is simple, the material employed is cheap, and the process rapid and effectual. As the preservative principle in Robbins' process is the same as that of Bethell, the durability of wood so prepared is demonstrated by Bethell's experiments, and confirmed, by the experience of a quarter of a century.

Since it is assumed that wood treated by Robbins' process will last for twenty-five years, in the most exposed situations, and that this fact is established beyond reasonable doubt by the application of the same antiseptic principle in Bethell's imperfect method, the public should insist on an examination of the claim. If it be well founded, let the rotten timber be replaced by imperishable timber. If durability can be easily obtained, we should insist on having it in the materials of railways. It is also a measure of economy, as well as one that involves the public safety.

THE WOOD-PRESERVING QUESTION.

The following decisive answer to a correspondent is copied from the *American Artizan*, in which it originally appeared, with the indorsement of the Editor of that excellent journal.

MESSRS. EDITORS:—It cannot have escaped your observation that wood, in its most useful applications, is rapidly destroyed by the natural process of decay, and by the ravages of several species of worms and insects. This is rendered inevitable by the ordinary atmospheric conditions to which it is necessarily exposed, and from which it is impossible to protect it, except by some artificial treatment that will make it less perishable. In my travels through the United States I have noticed that the chief and more accessible sources of the supply of timber—even in the great West—are being rapidly diminished, and of necessity they must be finally exhausted, unless by some means this rapid waste of wood can be arrested. If any such means have been discovered, will you give me such reliable information as you possess, whether derived from your own scientific investigations, or from the experimental observations of others? Your compliance with this request may be of service to the public, and will greatly oblige your obedient servant,

GEORGE P. IHRIE.

DENVER, COLORADO, September 19, 1866.

ANSWER.

We cheerfully furnish our correspondent such information as we have on the general subject embraced in his letter. In Europe at least six patents have been granted, and one or more in this country, for various processes for preserving wood from decay. Five of the six patents obtained in Europe have covered the use of certain metallic solutions and the several modes of their application. The substances employed in this general method of treating wood are, corrosive sublimate, chloride of zinc, sulphate of copper, and sulphate of iron, in connection with carbonate of soda.

The mode of applying the metallic compounds, which is both difficult and expensive, may be briefly described. The metallic substances are first dissolved in water, the air is then partially removed from the iron receptacle containing the wood to be treated, by the use of pumps attached to the apparatus for that purpose. The solution is then forced into the wood by a pressure of some one hundred and fifty pounds to the square inch, the pressure being continued until the operation is completed.

As it is conceded by the best authorities that the decay of wood is caused by the combined action of oxygen and moisture, it is scarcely possible that this treatment should preserve it from decay for any great length of time. To be sure, corrosive sublimate coagulates the albumen of the sap; other metallic compounds may produce a similar effect, and so far the treatment is beneficial; but as the pores of the wood are still open and the fibrous portions left exposed to all the changes of temperature and moisture, it yet lacks

the most essential conditions to its preservation. Moreover, there appear to be grave objections to the use of the metallic solutions. The principal of these may be briefly stated. The effect of such a treatment is to diminish the elasticity of the ligneous fibre. This is inevitable from the very nature of the materials employed; and it constitutes a serious objection, for the reason that the elastic quality of wood is of the first importance in its chief relations to the mechanic arts. The metallic compounds, however applied, are further objectionable because *they are powerful oxydizing agents.* The metals, especially iron and copper—in connecting-rods and bars, in bolts, rivets and nails—are extensively used in such of the more important works as are chiefly constructed of wood. The integrity of these as much depends on the preservation of the metals from corrosion as on the soundness of the timber, and hence the inutility of such a treatment of the latter as inevitably increases that corrosion must be self-evident.

Among the European inventors—having for their object the preservation of wood from decay—one only rejected the metallic solutions, and substituted, in a crude form, the products of tar. In England this treatment had well-nigh taken the place of all other substances and methods, until the recent introduction of the American invention by Mr. Louis S. Robbins, of this city. The Robbins process properly contemplates the use of either coal or wood tar, rosin or asphaltum; the selection of the particular material being determined by considerations of convenience and economy—the antiseptic elements necessary to the preservation of wood existing in all the above named substances.

In the peculiar mode of applying his materials Mr. Robbins appears to have achieved a great success. Instead of using the substances named in a crude form, he converts them into vapor by the application of the requisite degree of heat, in which state they readily enter into and pervade the entire substance of the wood. In the English process of using tar the oil derived from the distillation was attempted to be forced into and through the pores by purely artificial means. This, of necessity, could only result in a very superficial impregnation of the wood, while the same or a similar material, made more than one thousand times finer and more penetrating by being vaporized, readily finds its way into the smallest spaces of the cellular structure, and thus the wood is impregnated in the most rapid and effectual manner. The specific effects of the treatment may be thus briefly enumerated:

1. The application of heat and the creosote that, by a subtle process of infiltration, is made to permeate the wood, has the effect to thoroughly coagulate the albumen of the sap, thus rendering it insoluble in water and incapable of putrefaction.

2. The antiseptic elements arising from the distillation fill the pores of the wood far more effectually than they can be otherwise closed by the adoption of such methods as usually accompany the use of the metallic compounds.

3. The heavy oleaginous product derived from tar, rosin, and other simi-

lar substances not only protects the fibre from moisture, but it also preserves its elastic quality.

4. This treatment prevents the generation of infusoria within the pores of the wood; parasites will not attach themselves to its surface; at the same time it affords a complete protection against marine worms and all the insects that bore wood in a dry atmosphere. It is also to be observed that this treatment seasons green wood immediately and perfectly.

5. The necessary apparatus for treating wood by the Robbins process involves but a small expense compared with the cost of the necessary machinery employed in connection with the various metallic solutions.

The query that relates to the comparative cost of the two general methods of treating wood—already described—will naturally arise in the mind of the inquirer, especially if he be disposed to take a business view of the subject. This important question may be satisfactorily disposed of, perhaps, by simply quoting the present New York market value (Oct. 1st) of the several substances employed, respectively, in the treatment of wood:

PRICES OF THE METALLIC COMPOUNDS, USED IN SOLUTION: Chloride of Zinc (large quantities) per lb., $1 50; Corrosive Sublimate, $1 10; Sulphate of Copper, 12½ cents; Carbonate of Soda, 10 cents.

PRICES OF BITUMINOUS SUBSTANCES: Asphaltum, per lb., 8 cents; Rosin, 1½ cents; Wood Tar, 1¼ cents; Coal Tar, 1 cent.

The foregoing facts and considerations naturally lead us to the conclusion, that the materials and the process employed by Mr. Robbins are decidedly superior to any of the means and methods heretofore adopted, in the progress of modern art, for the preservation of wood, as well from the attacks of microscopic and other insects as from the natural process of decay.—EDS.

LEGAL OPINION OF THE ROBBINS PATENT.

When about to purchase the invention known as the "Robbins Process," the *Philadelphia Company* required this Company to furnish them with the written opinion of that eminent Patent Lawyer, Charles M. Keller, Esq., of the city of New York, which is as follows:

My opinion is requested as to the validity and legal scope of Letters Patent granted to Louis S. Robbins for a Process for Preserving Wood from mold and decay, and assigned to the "National Patent Wood Preserving Company," and also whether the process so patented is valuable.

The invention described in this patent is a process for more effectually impregnating wood to be preserved, with oleaginous compounds, than by any other process before known; and the process so described consists in applying heat to the wood to vaporize the moisture contained in its pores for some distance from the surface inwards, and after the moisture has been expelled, and the pores are opened by the heat, applying the oleaginous compounds in the condition of vapor, that they may more freely enter the pores, and become solidified therein by condensation, thus effectually sealing up the pores of the wood. The apparatus described in the patent consists of a retort, in which the oleaginous substances are distilled. The retort is connected with a chamber suitably formed to receive the wood to be treated, and into which the oleaginous vapors from the retort are introduced.

It has long since been established as a fact, that wood will not decay if it can be protected against the action of moisture. Moisture under the influences of changes of temperature is the destroyer of vegetable substances, and if a piece of wood were thoroughly dried and put in a glass tube, and, then sealed up, it is admitted that it would not decay.

The process described in the patent in question is based on this established fact, and the rationale is to first expel the moisture contained in the pores of the wood, and then fill up the pores with a substance or substances which will not be affected either by moisture or by any other changes of atmospheric temperature.

Nearly all the processes heretofore invented for the preservation of wood have been based on this well-established fact. The difficulty has been to

find some means by which wood, which is a porous substance, could be effectually sealed up, so as to exclude moisture, when exposed in use, as it must generally be, in the presence of moisture. Science has long since established the cause of decay, and what is required to prevent it, and has presented to inventive genius the more difficult task of finding out the means by which it is to be effected.

Prior to the invention of the process described in the patent in question, ingenious minds have been directed to the finding out of the kinds of substances which, when introduced into the pores of the wood, would effectually exclude moisture to prevent its destructive effects, and as the result of these efforts, a considerable catalogue of anti-septics has been produced, most of which will effectually preserve wood; but the discovery of the efficacious properties of these various substances was not sufficient; one branch of the important problem was yet undiscovered, and that was a means of effectually, practically and cheaply sealing up the pores of the wood with some suitable anti-septic.

Most of the attempts have been to drive out the moisture contained in the wood by the anti-septic agent in the liquid or semi-liquid form. To drive out of the pores one liquid by another, and cause that other, when so substituted, to assume the permanent solid state was the difficulty. Many trials have been made in that direction, and with success, but the processes are too slow and expensive, and for that reason have not been extensively used.

In my opinion, the process described in the patent submitted to me, is *effectual*, *practical* and *cheap*, and *is based on sound principles*. Instead of attempting to drive out one liquid by another, it consists in driving the moisture out of the pores of the wood by the application of heat, which performs the duty by vaporizing such liquid, and whilst the pores of the wood are still expanded by heat, introducing vapors obtained from the distillation of oleaginous substances, which vaporize at a much higher temperature than the liquids previously contained in the pores of the wood.

In the gaseous form, these substances readily enter the pores of the wood, and are there, by condensation, gradually reduced to the solid form, until the pores become thoroughly filled and sealed up, and as the oleaginous substances thus introduced are not affected by moisture, or by the changes of atmospheric temperature, and are thoroughly anti-septic, it results that wood so treated will be effectually protected against decay, and for many purposes materially improved.

It is stated in the specification of the patent, that the preferred mode of working the process is by the apparatus described, but, as will be obvious, that the claim of invention is not limited to the use of such, or of any other apparatus, as the said process can be worked by any apparatus in which

the wood to be treated can be exposed to the required heat to vaporize the moisture contained in its pores, used in connection with any suitable retort or vessel in which the oleaginous substances can be distilled, and the vapors discharged into the chamber in which wood has been heated to expel the moisture.

And it is further stated that the preferred mode, because it is obviously the cheapest, is to expel the moisture from the wood by the oleaginous vapors with which the wood is to be charged, although the claim of the invention is not limited to such mode of working the process, but that it is best, must be obvious, for the reason that the oleaginous substances vaporize at a much higher temperature than the liquids to be driven out, so that these vapors after vaporizing and expelling the moisture, and entering the pores of the wood, will be then condensed by being cooled down to a temperature below that at which they were vaporized.

The process in my opinion is not only new and patentable, but highly useful. The patent is valid, and the legal scope of the claim is such, that it will cover every possible means of expelling the moisture by the application of a sufficient heat to vaporize it, and then applying the vapor obtained from the distillation of oleaginous substances, whether the heat for expelling the moisture be applied by the vapors which are to impregnate the wood, or by other means.

Signed, CHARLES M. KELLER.

July 2d, 1867.